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Test Report on Sulfur Dioxide Emissions Testing #266.16

Hydrite Chemical Co
Terre Haute, IN

Wilcox Project # 266.16

January 12, 2017

Prepared For:

Hydrite Chemical Co
2400 Erie Canal Road
Terre Haute, IN 47802

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EXECUTIVE SUMMARY

Wilcox Environmental Engineering, Inc. – Air Analysis Services (Wilcox) was contracted by Hydrite Chemical Company to sample air emissions at their facility in Terre Haute, Indiana on December 6th, 2016. The Burner 1 (ST-260) unit was tested to evaluate emissions of Sulfur Dioxide (SO_2). The testing program was performed consistent with US EPA Methods 1-4, 6C. The test results are summarized below in Table ES-1. Three locations surrounding the scrubber installed on ST-260 were tested to determine the efficiency of the scrubber. The burner does not operate without the scrubber system also operating.

Table ES-1. Emissions Results Summary

Date	Test Condition	Test Parameter	Result
12/07/16	SBS Only	Scrubber Efficiency (%)	93.2
	SBS & MBS	Scrubber Efficiency (%)	91.0

1.0 INTRODUCTION

Wilcox Environmental Engineering, Inc. (Wilcox) has prepared this source test report on behalf of Hydrite Chemical Co (Hydrite). Wilcox conducted source emissions testing on December 6th at the facility in Terre Haute, IN in fulfillment of the submitted test plan for Burner 1 (ST-260) in accordance with the EPA 114 Letter Request received by Hydrite. Three locations surrounding the scrubber installed on ST-260 were tested to determine the efficiency of the scrubber. The burner does not operate without the scrubber control system active.

Table 1-1 below presents the emission unit(s) and parameters that were tested. The test was conducted in accordance with approved Environmental Protection Agency (EPA) Registered Test Methods and the accepted EPA Compliance Test Protocol included in the Appendix of this document.

Table 1-1. Emissions Sampling Summary

TEST LOCATION	PARAMETER	TEST METHOD	# OF TEST RUNS	SAMPLE DURATION (MIN)	ANALYTICAL APPROACH
PRE-SCRUBBER	SULFUR DIOXIDE	USEPA METHOD 6C	3	60	UV ABSORPTION
STRIPPER VENT	SULFUR DIOXIDE	USEPA METHOD 6C	3	60	UV ABSORPTION
POST SCRUBBER	SULFUR DIOXIDE	USEPA METHOD 6C	3	60	UV ABSORPTION
POST MIST ELIMINATOR	EXHAUST FLOW	USEPA METHOD 1,2	3	60	PITOT TUBE
	EXHAUST TEMP	USEPA METHOD 1,2	3	60	THERMOCOUPLE
	O2/CO2	USEPA METHOD 3A	3	60	NDIR/PARAMAGNETIC
	MOISTURE	USEPA METHOD 4	3	60	GRAVIMETRIC

Table 1-2. Project Personnel

Firm	Contact	Title	Phone No.
Wilcox	Dave Williams	Senior Project Manager	317.472.0999
Wilcox	Mike Murphy	Field Technician	317.472.0999
Wilcox	William Syphers	Field Technician	317.472.0999
Hydrite	Ken Yass	Technical Regulatory Manager	262.792.8736
Hydrite	Loren Meisinger	Regional SQRA Manager	812.232.5411
Hydrite	Jordan Abrell	EHS Coordinator	812.232.5411
EPA	Kenneth Rufato	Environmental Engineer	312.886.7886
EPA	Ethan Chatfield	Environmental Engineer	312.886.5112

2.0 FACILITY DESCRIPTION AND SOURCE INFORMATION

Hydrite Chemical (Hydrite), located in Terre Haute, Indiana, manufactures bisulfites such as sodium bisulfite (SBS) and magnesium bisulfite (MBS). Sulfur dioxide is a primary ingredient in the manufacturing of bisulfites. It is in the best interest of Hydrite to capture as much sulfur dioxide as possible from it's sulfur burners. The process was operating within the specified conditions in the attached test protocol (Appendix D) during the testing event. An aerial view of the facility is included below in Figure 2-1.

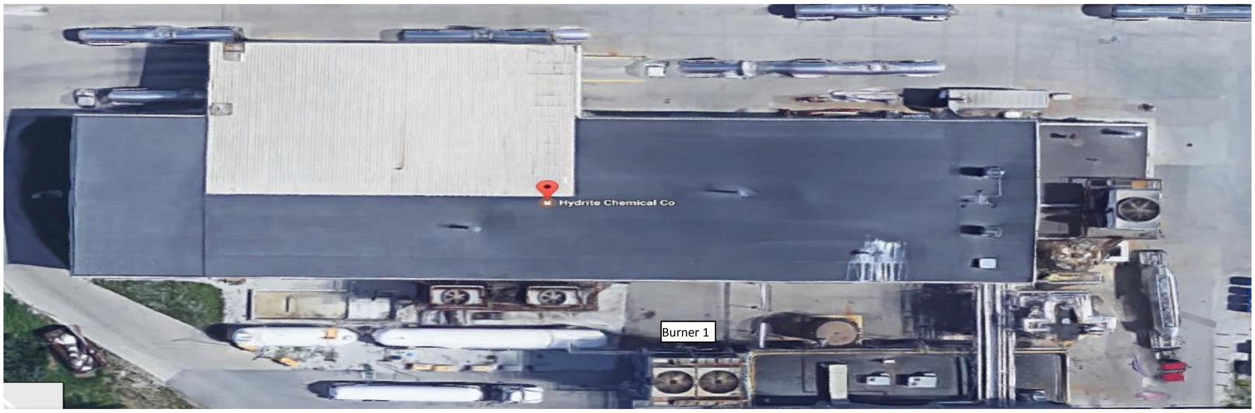

Figure 2-1. Aerial View of Facility

The source tested consists of Burner 1 (ST-260). The burner was tested at four different locations within the process. Sulfur dioxide was measured at the pre-scrubber, stripper vent and post scrubber sampling locations. Due to safety and feasibility, flow rates and moisture were measured at the post mist eliminator sampling location. Flow rates from the stripper vent were estimated from process designs. The flow rate at the pre-scrubber was calculated by subtracting the stripper vent flow rate from the measured post-mist eliminator flow rate. The post-scrubber flow rate was assumed to be equal to the post mist eliminator flow rate. Figure 2-2 below shows a process diagram which indicates the sampling points for this test event.

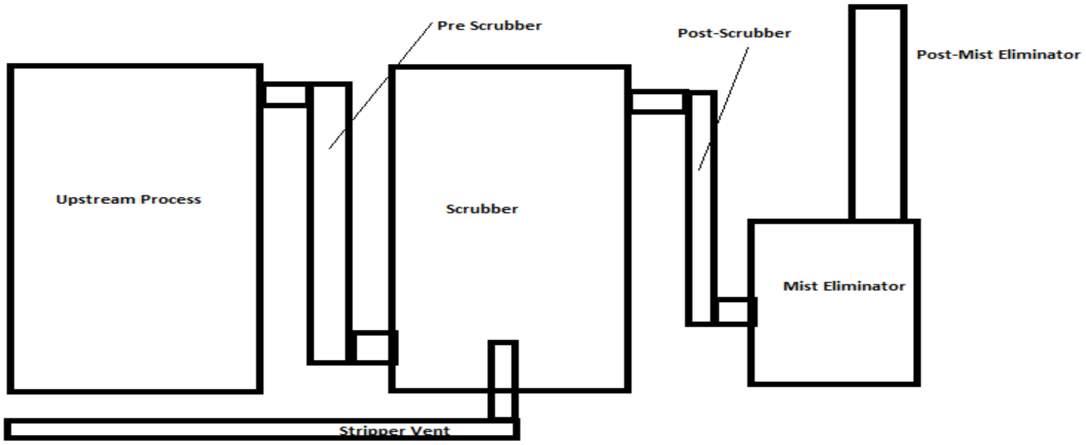

Figure 2-2. Hydrite Process Diagram

3.0 SUMMARY OF EVENTS AND RESULTS

3.1 Burner 1 (SBS Only)

Wilcox conducted emissions sampling for sulfur dioxide (SO_2) utilizing the aforementioned US EPA registered methods from 2:15 p.m. to 5:40 p.m. on December 6th, 2016. Table 3-1 displays detailed results of the test program. The stack test was conducted while burner 1 was operating at 95% or more of the process throughout rates listed in the previously submitted stack test protocol (19,440 lb/hr SBS, 4,008 lb/hr MBS & SBS), and with the burner temperature, pressure and air & sulfur blowers all operating at or near maximum capacity as planned.

Table 3-1. Summary of Results – Burner 1 (SBS Only)

Stack Gas Characteristics	Run 1 (14:15–15:15)	Run 2 (15:35–16:35)	Run 3 (16:40-17:40)	Average
Scrubber Efficiency (%)	92.9	93.0	93.7	93.2
Pre-Scrubber				
Flow Rate (dscfh)	164,955	163,201	163,075	163,744
Sulfur Dioxide (ppm)	847	819	931	866
Sulfur Dioxide (lbs/hr)	23.2	22.2	25.3	23.6
Stripper Vent				
Flow Rate (dscfh)	991	991	991	991
Sulfur Dioxide (ppm)	514	503	493	503
Sulfur Dioxide (lbs/hr)	0.085	0.083	0.081	0.083
Post Scrubber				
Flow Rate (dscfh)	165,946	164,192	164,066	164,735
Sulfur Dioxide (ppm)	59.0	58.3	58.1	58.5
Sulfur Dioxide (lbs/hr)	1.63	1.59	1.59	1.60
Post Mist Eliminator Stack Gas Data				
Dry Standard Cubic Feet / Minute	2,766	2,737	2,734	2,766
Avg. Stack Temp. (deg. F)	123.0	123.0	124.0	123.3
Stack Gas Velocity (feet/sec)	72.1	72.3	72.3	72.2
Avg. SQRT Velocity Head (inches)	1.20	1.20	1.20	1.20
% Moisture of Stack Gas	9.49	10.60	10.59	10.23
Sample Volume (cubic feet)	42.603	46.618	46.734	45.385

Note that the average pre-scrubber emission rate for the SBS only condition is 23.6 lbs/hr which, over a period of 20 minutes, equates to approximately 8 lb of SO2.

3.2 Burner 1 (SBS & MBS)

Wilcox conducted emissions sampling for sulfur dioxide (SO_2) utilizing the aforementioned US EPA registered methods from 6:05 p.m. to 9:30 p.m. on December 6th, 2016. Table 3-2 displays detailed results of the test program.

Table 3-2. Summary of Results – Burner 1 (SBS & MBS)

Stack Gas Characteristics	Run 1 (18:05–19:05)	Run 2 (19:15–20:15)	Run 3 (20:30-21:30)	Average
Scrubber Efficiency (%)	92.9	92.6	87.9	91.6
Pre-Scrubber				
Flow Rate (dscfh)	181,004	182,438	183,106	182,183
Sulfur Dioxide (ppm)	864	698	503	688
Sulfur Dioxide (lbs/hr)	26.0	21.2	15.3	1.62
Stripper Vent				
Flow Rate (dscfh)	991	991	991	991
Sulfur Dioxide (ppm)	515	505	521	514
Sulfur Dioxide (lbs/hr)	0.085	0.083	0.086	0.085
Post Scrubber				
Flow Rate (dscfh)	181,996	183,429	184,097	183,174
Sulfur Dioxide (ppm)	61.8	61.1	61.6	62.2
Sulfur Dioxide (lbs/hr)	1.87	1.86	1.89	1.90
Post Mist Eliminator Stack Gas Data				
Dry Standard Cubic Feet / Minute	3,033	3,057	3,068	3,053
Avg. Stack Temp. (deg. F)	120	121	120	120
Stack Gas Velocity (feet/sec)	81.8	82.6	82.7	82.4
Avg. SQRT Velocity Head (inches)	1.34	1.35	1.35	1.35
% Moisture of Stack Gas	10.71	10.72	10.61	10.68
Sample Volume (cubic feet)	44.498	45.280	45.882	45.220

4.0 METHODOLOGY

The sampling procedures used by Wilcox were performed according to Title 40 CFR Part 60 Appendix A and are as follows:

Table 4-1. Sampling Procedures

Method	Description
US EPA Method 1	Determination of Velocity Traverses for Stationary Sources
US EPA Method 2	Determination of Stack Gas Velocity and Volumetric Flow Rate
US EPA Method 3	Gas Analysis for the Determination of Molecular Weight
US EPA Method 4	Determination of Moisture Content in Stack Gas
US EPA Method 6C	Determination of Sulfur Dioxide Emissions from Stationary Sources

4.1 Sample Point Determination-EPA Method 1

Sampling point locations were determined according to EPA Reference Method 1.

Table 4-2. Sampling Points

Locations	Dimensions	Ports	Points Per Port	Total Points
Stack 1 Non-Particulate Traverse	12” ID	2	8	16

** Exact measurement points and distances to disturbances are listed in Appendix C - Field Data.

4.2 Velocity and Volumetric Flow Rate – EPA Method 2

EPA Method 2 was used to determine the gas velocity and flow rate at the stack. Each set of velocity determinations included the measurement of gas velocity pressure and gas temperature at each of the Method 1 determined traverse points. The velocity pressures were measured with a Type S pitot tube. Gas temperature measurements were made with a Type K thermocouple and digital pyrometer.

4.3 Gas Composition and Molecular Weight – EPA Method 3

The oxygen and carbon dioxide concentrations were determined in accordance with EPA Method 3 using a Fyrite analyzer. The remaining stack gas constituent was assumed to be nitrogen for the stack gas molecular weight determination.

4.4 Moisture Content – EPA Method 4

The flue gas moisture content at the testing locations was determined in accordance with EPA Method 4. The gas moisture was determined by quantitatively measuring condensed moisture in the chilled impingers and silica absorption. The amount of moisture condensed was determined gravimetrically. A dry gas meter was used to measure the volume of gas sampled. Moisture content is used to determine stack gas velocity.

4.5 SO2 Determination – EPA Method 6C

Stack gas is withdrawn from the stack and conditioned (moisture is removed) before being analyzed by ultra-violet (UV) detection. Sulfur Dioxide molecules are absorbed by specific wave lengths. Molecular absorption is directly proportional to the concentration of SO2. Quality assurance of the analyzer is first determined by direct injection of known EPA protocol 1 gas concentrations. A system check of the probe, connection lines and conditioner is also determined prior to and after each sample period to determine drift bias.

5.0 WILCOX QUALITY ASSURANCE AND QUALITY CONTROL

5.1 Sampling Protocol

Wilcox Environmental Engineering (Wilcox) is organized to facilitate sample management, analytical performance management, and data management. Personnel are assigned specific tasks to ensure implementation of the quality assurance/quality control (QA/QC) program. The Senior Project Manager in charge of air emission measurement projects reports directly to the Director of Air Analysis Services and are the QA officers responsible for program effectiveness and compliance.

The analysts perform the data reduction, analyses, and initial data review. Each analyst must check and initial their work, making certain that it is complete, determining that any instrumentation utilized has been properly calibrated, and ensuring that the analysis has been performed within the QA/QC limits.

The Senior Project Manager evaluates and verifies the data submitted by the analysts, verifies that the data and documentation are complete, confirms that all analysis has been performed within QA criteria specific to each method, checks calculations, assembles and signs the data package, and reviews the final report.

5.2 Equipment Maintenance and Calibration

The Field Supervisor and Field Technicians are in charge of routine maintenance and calibration of all source-testing equipment. Relevant calibration information is included in the Appendices of this report.

5.2.1 Equipment Maintenance

All major pieces of equipment have maintenance logs where all maintenance activities are recorded and documented. Table 5-1 shows routine maintenance that is performed on Wilcox source testing equipment.

Table 5-1. Test Equipment - Routine Maintenance Schedule

Equipment	Acceptance Limits	Frequency of Service	Methods of Service
Pumps	• Absence of leaks • Ability to draw vacuum within equipment specifications	Every 500 hours of operation or 6-months, whichever is less	• Visual inspection • Lubrication
Flow Meters	• Free mechanical movement • Absence of malfunction • Calibration within tolerance	Every 500 hours of operation or 6-months whichever is less	• Visual inspection • Clean • Calibrate
Electronic Instrumentation	• Absence of malfunction • Proper response to calibration gases and signals	As recommended by manufacturer or when required due to unacceptable limits	• Clean • Replace parts as necessary • Other recommended manufacturer service
Mobile Laboratory Sampling System	• Absence of leaks. • Sample lines clean and free of debris • Proper input flow rates to analyzers	At least once per month or sooner depending on nature of use.	• Change filters • Change gas dryer • Leak check • Check for contamination
Sample Lines	• Absence of soot and particulate buildup • Adequate sample flow	At least once per month or sooner depending on nature of use.	• Flush with solvents and water • Heat and purge line with nitrogen

5.2.2 Equipment Calibration

Current calibration information on equipment used during testing is included in the Appendices of this report.

The S-Type pitot tubes are calibrated initially upon purchase and then semiannually. Visual measurements are taken prior to each use to insure accidental damage has not occurred. Measurements are performed using a micrometer and protractor.

Each temperature sensor is marked and identified. This is done by marking each thermocouple end connector with a number. The sensor is calibrated as a unit with the control box potentiometer and associated lead wire as an identified unit. Calibrations are performed initially and annually at three set-points over the range of expected temperatures for that particular thermocouple. A reference output-voltage/thermocouple calibrator is used as a temperature reference source for the multi-point calibrations.

The field barometer is adjusted initially and semiannually to within 0.1" Hg of the actual atmospheric pressure at the Wilcox laboratory facility in Indianapolis, Indiana. All dry gas field meters are calibrated before initial use. Once the meter is placed in operation, its calibration is checked after each test series or bimonthly, whichever is less. Dry gas meters are calibrated against a NIST reference meter or orifice.

The dry gas meter orifice is calibrated before its initial use and then annually. This calibration is performed during the calibration of the dry gas test meter. The unit is checked in the field after every series of tests using a field gas-meter check procedure.

Analytical balances are internally calibrated prior to use following the manufacturer's instructions. The balances are further checked using Class S-1 analytical weights prior to daily usage. Field top loading balances are checked with a field analytical weight prior to usage.

6.0 LIMITATIONS AND SIGNATURES

Wilcox Environmental Engineering, Inc.'s (Wilcox's) services, data, opinions, and recommendations described in this report are for Client's sole and exclusive use, and the unauthorized use of or reliance on the data, opinions, or recommendations expressed herein by parties other than Wilcox's Client is prohibited without Wilcox's express written consent. The services described herein are limited to the specific project, property, and dates of Wilcox's work. No part of Wilcox's report shall be relied upon by any party to represent conditions at other times or properties. Wilcox will accept no responsibility for damages suffered by third parties as a result of reliance upon the data, opinions, or recommendations in this report.

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Wilcox has striven to perform the services in a manner consistent with that level of care and skill ordinarily exercised by other environmental consultants practicing in the same locality and under similar conditions existing at the time we performed our services. **No other warranty is either expressed or implied in this report or any other document generated in the course of performing Wilcox's services.**

Sincerely,
Wilcox Environmental Engineering, Inc.

Ernest Brummett
Project Manager

Dave Williams
Technical Director

APPENDICES

APPENDIX A

Sample Calculations

SAMPLE CALCULATIONS

The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

1. Volume of water collected ($wscf$)

$$V_{wstd} = (0.04707)(V_{lc})$$

Where:

V_{lc}	total volume of liquid collected in impingers and weighed silica gel (ml)
V_{wstd}	volume of water collected at standard conditions (ft^3)
0.04707	conversion factor (ft^3 / ml)

2. Volume of gas metered, standard conditions ($dscf$)

$$V_{mstd} = \frac{(17.64)(V_m)(P_{baro} + \frac{\Delta H}{13.6})(Y_d)}{(459.67 + T_m)}$$

Where:

P_{baro}	barometric pressure ($in.\ Hg$)
T_m	average dry gas meter temperature ($^\circ F$)
V_m	volume of gas sample through dry gas meter at meter conditions (ft^3)
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
Y_d	gas meter correction factor (*dimensionless*)
DH	average pressure drop across meter box orifice ($in.\ H_2O$)
17.64	conversion factor ($^\circ R / in.\ Hg$)
13.6	conversion factor ($in.\ H_2O / in.\ Hg$)
459.67	conversion constant ($^\circ F$ to $^\circ R$)

3. Sample gas pressure ($in.\ Hg$)

$$P_s = P_{baro} + (\frac{P_g}{13.6})$$

Where:

P_{baro}	barometric pressure ($in.\ Hg$)
P_g	sample gas static pressure ($in.\ Hg$)
P_s	absolute sample gas pressure ($in.\ H_2O$)
13.6	conversion factor ($in.\ H_2O\ /\ in.\ Hg$)

4. Actual vapor pressure ($in.\ Hg$)

$$P_v = P_s$$

Where:

P_v	vapor pressure, actual ($in.\ Hg$)
P_s	absolute sample gas pressure ($in.\ Hg$)

5. Moisture Content ($\%$)

$$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$$

Where:

B_{wo}	proportion of water vapor in gas stream by volume
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
V_{wstd}	volume of water collected at standard conditions (ft^3)

6. Saturated moisture content ($\%$)

$$B_{ws} = \frac{(P_v)}{(P_s)}$$

Where:

B_{ws}	proportion of water vapor in gas stream by volume at saturated conditions ($\%$)
P_v	vapor pressure, actual ($in.\ Hg$)
P_s	absolute sample gas pressure ($in.\ Hg$)

7. Molecular weight of dry gas stream ($lb/lb-mole$)

$$M_d = M_{CO_2}\frac{(CO_2)}{(100)} + M_{0_2}\frac{(O_2)}{(100)} M_{CO+N_2}\frac{(CO+N_2)}{(100)}$$

Where:

M_d	dry molecular weight of sample gas ($lb/lb-mole$)
M_{CO_2}	molecular weight of carbon dioxide ($lb/lb-mole$)
M_{O_2}	molecular weight of oxygen ($lb/lb-mole$)
M_{CO+N_2}	molecular weight of carbon monoxide and nitrogen ($lb/lb-mole$)
CO_2	proportion of carbon dioxide in the gas stream by volume ($\%$)
O_2	proportion of oxygen in the gas stream by volume ($\%$)
$CO+N_2$	proportion of carbon monoxide and nitrogen in gas stream by volume ($\%$)
100	conversion factor, ($\%$)

8. Molecular weight of sample gas ($lb/lb-mole$)

$$M_s = (M_d)(1-B_{ws}) + (M_{H_2O})(B_{wo})$$

Where:

M_d	dry molecular weight of sample gas ($lb/lb-mole$)
B_{wo}	proportion of water vapor in the gas stream by volume
M_{H_2O}	molecular weight of water ($lb/lb-mole$)
M_s	molecular weight of sample gas, wet basis ($lb/lb-mole$)

9. Velocity of sample gas ($ft/\sec$)

$$V_s = (K_p)(C_p)(\sqrt{\Delta P})(\sqrt{\frac{T_s + 459.67}{(M_s)(P_s)}})$$

Where:

K_p	velocity pressure coefficient (*dimensionless*)
C_p	pitot tube constant
M_s	molecular weight of sample gas, wet basis ($lb/lb-mole$)
P_s	absolute sample gas pressure ($in.\ Hg$)
T_s	average sample gas temperature ($^\circ F$)
V_s	average sample gas velocity ($ft/\sec$)
459.67	conversion constant ($^\circ F\ to\ ^\circ R$)

10. Total flow of sample gas ($acfm$)

$$Q_a = (60)(A_s)(V_s)$$

Where:

A_s	cross section area of sampling location (ft^2)
Q_a	volumetric flow rate at actual conditions ($acfm$)
V_s	average sample gas velocity ($ft/\sec$)
60	conversion factor (*seconds to minutes*)

11. Total flow of sample gas per minute ($dscfm$)

$$Q_{std} = \frac{(Q_a)(P_s)(17.64)(1 - B_{wo})}{(T_s + 459.67)}$$

Where:

B_{wo}	proportion of water vapor in the gas stream by volume
P_s	absolute sample gas pressure ($in.\ Hg$)
Q_a	volumetric flow rate at actual conditions ($acfm$)
Q_{std}/hr	volumetric flow rate at standard conditions ($dscfm * 60$)
T_s	average sample gas temperature ($^\circ F$)
17.64	conversion factor ($^\circ R\ /\ in.\ Hg$)
459.67	conversion constant ($^\circ F\ to\ ^\circ R$)

12. Total flow of sample gas per hour ($dscfh$)

$$Q_{std/hr} = \frac{(Q_a)(P_s)(17.64)(1-B_{wo})}{(T_s + 459.67)}$$

Where:

B_{wo}	proportion of water vapor in gas stream by volume
P_s	absolute sample gas pressure ($in.\ Hg$)
Q_a	volumetric flow rate at actual conditions ($acfm$)
$Q_{std/hr}$	volumetric flow rate at standard conditions ($dscfm * 60$)
T_s	average sample gas temperature ($^{\circ}F$)
17.64	conversion factor ($^{\circ}R / in.\ Hg$)
459.67	conversion constant ($^{\circ}F\ to\ ^{\circ}R$)

13. Percent Isokinetic (%)

$$I = \frac{0.09450\ (T_s)(V_{mstd})}{(P_s)(V_s)(\frac{(D_n)^2(\pi)}{(144)(4)})(\ell)(1-B_{wo})}$$

Where:

D_n	diameter of nozzle, inches
B_{wo}	proportion of water vapor in gas stream by volume
I	percent of isokinetic sampling (%)
P_s	absolute sample gas pressure ($in.\ Hg$)
T_s	average sample gas temperature ($^{\circ}F$)
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
V_s	average sample gas velocity ($ft/\sec$)
ℓ	total sample time in minutes
0.09450	constant

14. Pollutant concentration ($gr/dscf$)

$$C_{gr/dscf} = \frac{(15.43)(M_n)}{V_{mstd}}$$

Where:

$C_{gr/dscf}$	measured concentration in the gas stream, ($gr/dscf$)
M_n	pollutant collected, corrected for reagent blank, in grams
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
15.43	conversion factor (*grams to grains*)

15. Pollutant Emissions, Mass Emissions Rate (lbs/hr)

$$E_{lbs/hr} = \frac{(\mu g)(2.2046e-9)(Q_{std})(60)}{(V_{std})}$$

Where:

$E_{lbs/hr}$	mass emissions rate, pounds per hour
μg_{HCl}	micrograms of pollutant emissions
Q_{std}	volumetric flow rate at standard conditions, dry basis ($dscfm$)
V_{std}	volume at standard conditions
$2.2046e-9$	conversion factor (*pounds per microgram*)
60	conversion (*minutes per hour*)

16. Equation for ppm to lbs/hr:

$$\frac{lb}{hr} = \left[\frac{[conc]ppmV}{1{,}000{,}000}\right] x \frac{MW}{385.4\ ft^3/lb\ mol} x VolFlow x 60$$

17. Equation for lbs/MMB t u:

= lbs/scf * F - factor * (20.9/(20.9 - O2 measured))

PPMVD TO LB/HR
CONVERSION CALCULATIONS

1. **NO_x** $\frac{\text{ppm } NO_x}{8.3755 \times 10^6} = \frac{\text{lbs } NO_x}{\text{dscf}}$ **OR** $\text{ppm } NO_x \times 1.194 \times 10^{-7} = \frac{\text{lbs/}NO_x}{\text{dscf}}$

$$\frac{\text{lbs } NO_x}{\text{dscf}} \times \frac{\text{dscf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs/}NO_x}{\text{hr}}$$

2. **SO_2** $\frac{\text{ppm } SO_2}{6.0151 \times 10^6} = \frac{\text{lbs } SO_2}{\text{dscf}}$ **OR** $\text{ppm } SO_2 \times 1.660 \times 10^{-7} = \frac{\text{lbs/ } SO_2}{\text{dscf}}$

$$\frac{\text{lbs } SO_2}{\text{dscf}} \times \frac{\text{dscf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs/ } SO_2}{\text{hr}}$$

3. **CO** $\frac{\text{ppm CO}}{1.3762 \times 10^7} = \frac{\text{lbs CO}}{\text{dscf}}$

$$\frac{\text{lbs CO}}{\text{dscf}} \times \frac{\text{dscf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs CO}}{\text{hr}}$$

4. **CH_4** $\frac{\text{ppm } CH_4}{(1-\text{Bws})\ 2.4017 \times 10^2} = \frac{\text{lbs } CH_4}{\text{dscf}}$

$$\frac{\text{lbs } CH_4}{\text{dscf}} \times \frac{\text{dscf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs } CH_4}{\text{hr}}$$

5. **$C_3 H_2$** $\frac{\text{ppm } C_3 H_2}{(1-\text{Bws})\ 8.7573 \times 10^6} = \frac{\text{lbs } C_3 H_2}{\text{dscf}}$

$$\frac{\text{lbs } C_3 H_2}{\text{dscf}} \times \frac{\text{dscf}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} = \frac{\text{lbs } C_3 H_2}{\text{hr}}$$

6. Oxygen Correction: Pollutant ppm * ((20.9 - 15)/(20.9 - oxygen measured))

APPENDIX B

Field Data Spreadsheets

		CH0001	CH0002	CH0003
		SO2 pre scrubber	SO2 post scrubber	SO2 stripper vent
2016/12/06	14:01	5.8	42.3	2.2
2016/12/06	14:02	5.8	56.8	2.3
2016/12/06	14:03	6.1	45.9	2.2
2016/12/06	14:04	6.1	61.0	2.4
2016/12/06	14:05	6.1	70.9	2.5
2016/12/06	14:06	6.1	42.6	2.1
2016/12/06	14:07	6.1	51.5	2.1
2016/12/06	14:08	6.8	63.5	2.6
2016/12/06	14:09	7.1	56.7	2.8
2016/12/06	14:10	7.1	87.8	3.6
2016/12/06	14:11	7.1	59.8	4.4
2016/12/06	14:12	7.1	50.3	4.4
2016/12/06	14:13	7.1	79.9	4.7
2016/12/06	14:14	7.4	75.9	3.9
2016/12/06	14:15	7.4	49.7	3.1
2016/12/06	14:16	7.4	48.1	2.6
2016/12/06	14:17	7.4	52.0	2.3
2016/12/06	14:18	7.4	48.6	2.1
2016/12/06	14:19	7.4	75.7	2.1
2016/12/06	14:20	7.4	65.8	2.1
2016/12/06	14:21	7.4	68.4	1.8
2016/12/06	14:22	7.7	54.3	1.6
2016/12/06	14:23	7.7	42.9	1.8
2016/12/06	14:24	7.7	51.5	2.1
2016/12/06	14:25	7.7	52.4	2.1
2016/12/06	14:26	7.7	72.4	2.1
2016/12/06	14:27	7.7	71.6	2.4
2016/12/06	14:28	8.0	48.8	2.6
2016/12/06	14:29	8.0	53.1	2.6
2016/12/06	14:30	8.0	56.1	2.6
2016/12/06	14:31	8.0	68.4	2.9
2016/12/06	14:32	8.0	42.0	2.9
2016/12/06	14:33	8.0	57.6	2.9
2016/12/06	14:34	8.0	60.1	3.2
2016/12/06	14:35	8.3	65.6	3.1
2016/12/06	14:36	8.3	69.6	3.1
2016/12/06	14:37	8.3	57.6	3.1
2016/12/06	14:38	8.3	57.0	3.4
2016/12/06	14:39	8.3	70.9	3.4
2016/12/06	14:40	8.3	52.4	3.4
2016/12/06	14:41	8.3	53.7	3.4
2016/12/06	14:42	8.3	61.8	3.4
2016/12/06	14:43	8.3	67.2	3.4
2016/12/06	14:44	8.6	57.6	3.4
2016/12/06	14:45	8.6	62.5	3.1
2016/12/06	14:46	8.6	72.6	3.1
2016/12/06	14:47	8.6	64.9	3.4
2016/12/06	14:48	8.6	46.8	3.7
2016/12/06	14:49	8.6	61.0	3.4
2016/12/06	14:50	8.6	66.3	3.4
2016/12/06	14:51	8.6	65.1	2.9
2016/12/06	14:52	8.9	66.6	2.9
2016/12/06	14:53	8.9	70.9	2.9
2016/12/06	14:54	8.9	59.2	2.9
2016/12/06	14:55	8.9	61.7	2.9
2016/12/06	14:56	8.9	67.3	3.0
2016/12/06	14:57	8.9	55.9	2.9
2016/12/06	14:58	8.9	59.8	2.9
2016/12/06	14:59	8.9	67.5	2.8
2016/12/06	15:00	8.9	65.9	2.9
Run 1 Average:		7.8	60.2	2.9

		CH0001	CH0002	CH0003
		SO2 pre scrubber	SO2 post scrubber	SO2 stripper vent
2016/12/06	15:36	7.2	58.6	2.7
2016/12/06	15:37	7.2	49.4	2.6
2016/12/06	15:38	6.9	41.8	2.6
2016/12/06	15:39	7.1	47.3	2.7
2016/12/06	15:40	7.2	56.1	2.6
2016/12/06	15:41	7.8	42.0	2.6
2016/12/06	15:42	7.1	60.6	2.6
2016/12/06	15:43	7.2	64.7	2.6
2016/12/06	15:44	7.2	49.9	2.6
2016/12/06	15:45	7.1	42.2	2.6
2016/12/06	15:46	7.2	57.0	2.6
2016/12/06	15:47	7.4	37.7	2.6
2016/12/06	15:48	7.5	54.3	2.6
2016/12/06	15:49	7.5	65.7	2.6
2016/12/06	15:50	7.5	62.0	2.6
2016/12/06	15:51	7.5	49.4	2.6
2016/12/06	15:52	7.5	55.0	2.6
2016/12/06	15:53	7.5	73.4	2.6
2016/12/06	15:54	7.2	58.3	2.6
2016/12/06	15:55	7.5	69.1	2.6
2016/12/06	15:56	7.5	62.6	2.6
2016/12/06	15:57	7.5	88.1	2.6
2016/12/06	15:58	7.5	61.1	2.6
2016/12/06	15:59	7.5	70.6	2.6
2016/12/06	16:00	7.7	52.7	2.6
2016/12/06	16:01	7.8	54.6	2.6
2016/12/06	16:02	7.4	62.0	2.6
2016/12/06	16:03	7.8	64.8	2.6
2016/12/06	16:04	7.8	62.9	2.6
2016/12/06	16:05	7.7	65.1	2.6
2016/12/06	16:06	7.8	58.0	2.6
2016/12/06	16:07	7.8	49.8	2.9
2016/12/06	16:08	7.8	59.3	2.6
2016/12/06	16:09	7.7	77.0	2.8
2016/12/06	16:10	7.8	62.2	2.9
2016/12/06	16:11	7.8	72.3	2.9
2016/12/06	16:12	7.7	60.9	2.9
2016/12/06	16:13	8.1	61.6	2.9
2016/12/06	16:14	8.1	67.2	2.9
2016/12/06	16:15	8.1	54.9	2.9
2016/12/06	16:16	8.1	62.9	8.7
2016/12/06	16:17	7.8	53.4	4.7
2016/12/06	16:18	7.7	51.2	3.9
2016/12/06	16:19	7.8	70.6	3.4
2016/12/06	16:20	7.8	57.1	3.4
2016/12/06	16:21	8.0	64.2	3.4
2016/12/06	16:22	8.1	63.3	3.1
2016/12/06	16:23	8.1	63.3	3.2
2016/12/06	16:24	8.1	53.4	3.1
2016/12/06	16:25	8.1	47.0	3.1
2016/12/06	16:26	8.1	59.9	2.9
2016/12/06	16:27	8.4	46.9	2.9
2016/12/06	16:28	8.1	62.3	2.8
2016/12/06	16:29	8.4	70.0	2.9
2016/12/06	16:30	8.3	52.5	2.9
2016/12/06	16:31	8.4	70.9	2.9
2016/12/06	16:32	8.0	42.7	2.9
2016/12/06	16:33	8.0	53.1	2.6
2016/12/06	16:34	8.1	50.4	2.6
2016/12/06	16:35	8.1	76.6	2.6
Run 2 Average:		7.7	58.9	2.9

		CH0001	CH0002	CH0003
		SO2 pre scrubber	SO2 post scrubber	SO2 stripper vent
2016/12/06	16:46	8.4	53.7	2.6
2016/12/06	16:47	8.4	80.2	2.6
2016/12/06	16:48	8.4	50.4	2.6
2016/12/06	16:49	8.4	60.9	2.6
2016/12/06	16:50	8.4	69.8	2.6
2016/12/06	16:51	8.4	45.7	2.6
2016/12/06	16:52	8.4	42.6	2.6
2016/12/06	16:53	8.4	73.4	2.6
2016/12/06	16:54	8.4	43.2	2.6
2016/12/06	16:55	8.4	46.0	2.6
2016/12/06	16:56	8.3	89.7	2.6
2016/12/06	16:57	8.4	46.6	2.6
2016/12/06	16:58	9.0	48.2	2.8
2016/12/06	16:59	8.4	67.6	2.9
2016/12/06	17:00	8.7	68.8	2.8
2016/12/06	17:01	8.7	65.7	2.9
2016/12/06	17:02	9.0	52.6	2.9
2016/12/06	17:03	8.7	48.3	2.9
2016/12/06	17:04	8.7	37.8	2.9
2016/12/06	17:05	8.7	52.2	2.9
2016/12/06	17:06	8.7	65.3	2.9
2016/12/06	17:07	8.6	55.7	2.9
2016/12/06	17:08	8.7	75.8	2.9
2016/12/06	17:09	8.7	59.1	2.9
2016/12/06	17:10	8.7	63.5	2.9
2016/12/06	17:11	8.4	50.3	2.9
2016/12/06	17:12	8.4	58.0	2.9
2016/12/06	17:13	8.4	68.8	2.9
2016/12/06	17:14	8.7	70.6	2.9
2016/12/06	17:15	8.7	58.3	2.9
2016/12/06	17:16	9.0	97.1	2.9
2016/12/06	17:17	8.7	52.6	2.9
2016/12/06	17:18	9.3	66.4	2.9
2016/12/06	17:19	9.3	75.9	2.9
2016/12/06	17:20	8.7	46.7	2.9
2016/12/06	17:21	8.6	60.2	2.9
2016/12/06	17:22	8.7	59.0	2.9
2016/12/06	17:23	8.7	48.2	2.9
2016/12/06	17:24	8.7	58.9	2.9
2016/12/06	17:25	8.7	57.1	2.9
2016/12/06	17:26	8.7	64.5	2.9
2016/12/06	17:27	8.6	57.7	2.9
2016/12/06	17:28	8.4	67.3	2.9
2016/12/06	17:29	8.4	52.5	2.9
2016/12/06	17:30	8.4	71.6	2.9
2016/12/06	17:31	8.4	48.0	2.6
2016/12/06	17:32	8.4	61.5	2.6
2016/12/06	17:33	8.4	51.6	2.6
2016/12/06	17:34	8.4	46.6	2.6
2016/12/06	17:35	9.0	71.5	2.9
2016/12/06	17:36	9.0	56.4	2.6
2016/12/06	17:37	9.0	53.0	2.6
2016/12/06	17:38	9.0	51.2	2.6
2016/12/06	17:39	8.7	43.9	2.9
2016/12/06	17:40	8.7	53.4	2.6
2016/12/06	17:41	8.7	78.4	2.6
2016/12/06	17:42	8.7	47.0	2.6
2016/12/06	17:43	8.7	42.4	2.6
2016/12/06	17:44	8.7	61.8	2.6
2016/12/06	17:45	8.7	52.0	2.6
Run 3 Average:		8.6	58.7	2.8

		CH0001	CH0002	CH0003
		SO2 pre scrub	2 post scrub	2 stripper vent
2016/12/06	18:06	8.4	64.8	2.6
2016/12/06	18:07	8.4	71.6	2.6
2016/12/06	18:08	8.4	55.0	2.9
2016/12/06	18:09	8.4	57.8	2.9
2016/12/06	18:10	8.4	45.5	2.9
2016/12/06	18:11	8.4	62.7	2.6
2016/12/06	18:12	8.4	60.6	2.9
2016/12/06	18:13	8.4	50.8	2.9
2016/12/06	18:14	8.4	59.4	2.9
2016/12/06	18:15	8.4	74.4	2.9
2016/12/06	18:16	8.0	66.1	2.9
2016/12/06	18:17	8.1	65.2	2.9
2016/12/06	18:18	8.1	57.1	2.9
2016/12/06	18:19	8.1	64.6	2.9
2016/12/06	18:20	8.1	56.8	2.9
2016/12/06	18:21	8.1	55.0	2.9
2016/12/06	18:22	8.1	63.3	2.9
2016/12/06	18:23	8.1	65.8	2.6
2016/12/06	18:24	9.6	57.5	2.9
2016/12/06	18:25	8.4	58.4	2.9
2016/12/06	18:26	8.4	78.1	2.9
2016/12/06	18:27	8.3	72.3	2.8
2016/12/06	18:28	8.4	49.6	2.9
2016/12/06	18:29	8.4	68.3	2.9
2016/12/06	18:30	8.4	59.0	2.9
2016/12/06	18:31	8.4	71.2	2.9
2016/12/06	18:32	8.4	65.0	2.9
2016/12/06	18:33	8.4	55.2	2.9
2016/12/06	18:34	8.4	50.6	2.9
2016/12/06	18:35	8.0	54.6	2.8
2016/12/06	18:36	8.1	76.9	2.9
2016/12/06	18:37	8.0	56.8	2.6
2016/12/06	18:38	8.1	59.0	2.9
2016/12/06	18:39	7.8	66.7	2.6
2016/12/06	18:40	7.8	57.8	2.9
2016/12/06	18:41	7.8	76.6	2.9
2016/12/06	18:42	7.8	61.9	2.6
2016/12/06	18:43	7.8	57.9	2.6
2016/12/06	18:44	7.8	74.4	2.6
2016/12/06	18:45	7.8	71.3	2.9
2016/12/06	18:46	7.7	49.5	2.8
2016/12/06	18:47	7.8	69.2	2.9
2016/12/06	18:48	7.7	55.6	2.9
2016/12/06	18:49	7.8	73.8	2.9
2016/12/06	18:50	7.8	69.2	2.9
2016/12/06	18:51	7.8	64.3	2.6
2016/12/06	18:52	8.4	53.2	2.9
2016/12/06	18:53	8.1	61.5	2.6
2016/12/06	18:54	8.1	65.8	2.9
2016/12/06	18:55	8.1	56.9	2.9
2016/12/06	18:56	7.8	67.7	2.6
2016/12/06	18:57	7.8	67.1	2.9
2016/12/06	18:58	7.8	60.6	2.9
2016/12/06	18:59	7.7	59.3	2.9
2016/12/06	19:00	7.8	78.6	2.9
2016/12/06	19:01	7.8	61.1	2.9
2016/12/06	19:02	7.5	58.9	2.9
2016/12/06	19:03	7.5	59.3	2.9
2016/12/06	19:04	7.5	68.9	2.9
2016/12/06	19:05	7.5	70.4	2.9
Run 1 Average:		8.1	62.8	2.8

		CH0001	CH0002	CH0003
		SO2 pre scrubber	SO2 post scrubber	SO2 stripper vent
2016/12/06	19:16	7.2	53.8	2.6
2016/12/06	19:17	7.2	55.6	2.6
2016/12/06	19:18	7.2	64.3	2.9
2016/12/06	19:19	7.2	42.7	2.6
2016/12/06	19:20	7.2	53.5	2.9
2016/12/06	19:21	7.2	55.3	2.9
2016/12/06	19:22	7.2	78.1	2.9
2016/12/06	19:23	6.8	43.7	2.9
2016/12/06	19:24	6.9	62.2	2.9
2016/12/06	19:25	6.9	62.5	2.6
2016/12/06	19:26	7.1	65.8	2.9
2016/12/06	19:27	6.8	70.3	2.9
2016/12/06	19:28	6.9	67.2	2.9
2016/12/06	19:29	6.9	51.6	2.9
2016/12/06	19:30	6.9	70.6	2.9
2016/12/06	19:31	6.9	50.1	2.9
2016/12/06	19:32	6.9	52.0	2.9
2016/12/06	19:33	6.8	73.8	2.9
2016/12/06	19:34	6.8	58.4	2.9
2016/12/06	19:35	6.9	71.7	2.9
2016/12/06	19:36	6.9	68.6	2.9
2016/12/06	19:37	6.8	67.7	2.9
2016/12/06	19:38	6.5	65.6	2.9
2016/12/06	19:39	6.5	65.3	2.9
2016/12/06	19:40	6.5	76.6	2.9
2016/12/06	19:41	6.5	60.6	2.9
2016/12/06	19:42	6.5	47.4	2.9
2016/12/06	19:43	6.5	72.6	2.9
2016/12/06	19:44	6.5	65.2	2.9
2016/12/06	19:45	6.5	41.5	2.6
2016/12/06	19:46	6.5	52.3	2.9
2016/12/06	19:47	6.5	76.0	2.9
2016/12/06	19:48	6.2	56.0	2.6
2016/12/06	19:49	6.2	66.1	2.9
2016/12/06	19:50	6.5	76.3	2.6
2016/12/06	19:51	6.2	65.9	2.9
2016/12/06	19:52	6.2	65.3	2.9
2016/12/06	19:53	6.2	72.4	2.9
2016/12/06	19:54	6.2	68.6	2.6
2016/12/06	19:55	6.2	57.1	2.6
2016/12/06	19:56	6.2	63.5	2.6
2016/12/06	19:57	6.2	57.7	2.6
2016/12/06	19:58	6.2	71.9	2.6
2016/12/06	19:59	6.2	50.1	2.6
2016/12/06	20:00	6.2	56.9	2.9
2016/12/06	20:01	6.2	75.4	2.9
2016/12/06	20:02	5.9	78.4	2.9
2016/12/06	20:03	6.0	61.5	2.6
2016/12/06	20:04	5.9	57.8	2.9
2016/12/06	20:05	5.9	66.8	2.9
2016/12/06	20:06	5.9	66.3	2.6
2016/12/06	20:07	5.9	45.3	2.9
2016/12/06	20:08	5.9	81.5	2.6
2016/12/06	20:09	5.9	36.0	2.6
2016/12/06	20:10	5.9	59.7	2.6
2016/12/06	20:11	5.9	56.9	2.9
2016/12/06	20:12	5.9	62.1	2.6
2016/12/06	20:13	5.9	48.6	2.6
2016/12/06	20:14	5.6	58.7	2.6
2016/12/06	20:15	5.6	59.7	2.9
Run 2 Average:		6.5	61.8	2.8

		Diluted CH0001 SO2 pre scrubber	CH0002 SO2 post scrubber	CH0003 SO2 stripper vent
2016/12/06	20:26	5.3	65.1	2.9
2016/12/06	20:27	5.3	59.9	2.9
2016/12/06	20:28	5.3	49.8	2.6
2016/12/06	20:29	5.9	68.9	2.6
2016/12/06	20:30	5.6	62.4	2.6
2016/12/06	20:31	5.6	67.4	2.9
2016/12/06	20:32	5.6	59.7	2.6
2016/12/06	20:33	5.6	65.9	2.6
2016/12/06	20:34	5.3	52.1	2.9
2016/12/06	20:35	5.3	64.0	2.6
2016/12/06	20:36	5.3	66.2	2.9
2016/12/06	20:37	5.0	49.2	2.9
2016/12/06	20:38	5.0	82.5	2.9
2016/12/06	20:39	5.0	71.7	2.9
2016/12/06	20:40	5.0	62.5	2.9
2016/12/06	20:41	5.0	78.7	2.9
2016/12/06	20:42	5.0	57.2	2.9
2016/12/06	20:43	5.0	69.2	2.9
2016/12/06	20:44	5.0	65.5	2.6
2016/12/06	20:45	5.0	63.4	2.6
2016/12/06	20:46	5.0	49.9	2.9
2016/12/06	20:47	4.7	67.1	2.6
2016/12/06	20:48	4.7	53.0	2.6
2016/12/06	20:49	4.7	69.9	2.6
2016/12/06	20:50	4.7	42.8	2.9
2016/12/06	20:51	4.7	44.2	2.9
2016/12/06	20:52	4.7	61.7	2.9
2016/12/06	20:53	4.7	69.1	2.9
2016/12/06	20:54	4.7	75.3	2.9
2016/12/06	20:55	4.7	47.3	2.9
2016/12/06	20:56	4.7	60.9	2.9
2016/12/06	20:57	4.4	58.5	2.9
2016/12/06	20:58	4.7	51.7	2.9
2016/12/06	20:59	4.4	60.6	2.8
2016/12/06	21:00	4.7	67.4	2.9
2016/12/06	21:01	4.7	57.6	2.9
2016/12/06	21:02	4.4	63.2	2.9
2016/12/06	21:03	4.4	79.7	2.9
2016/12/06	21:04	4.4	73.9	2.9
2016/12/06	21:05	4.4	79.7	2.9
2016/12/06	21:06	4.4	58.8	2.9
2016/12/06	21:07	4.4	68.6	2.9
2016/12/06	21:08	4.4	61.5	2.9
2016/12/06	21:09	4.4	70.1	2.9
2016/12/06	21:10	4.4	52.3	2.9
2016/12/06	21:11	4.4	43.1	2.9
2016/12/06	21:12	4.4	62.8	2.9
2016/12/06	21:13	4.4	66.2	2.9
2016/12/06	21:14	4.4	73.2	2.9
2016/12/06	21:15	4.1	61.0	2.9
2016/12/06	21:16	4.4	58.9	2.9
2016/12/06	21:17	4.4	54.5	2.9
2016/12/06	21:18	4.1	61.5	2.9
2016/12/06	21:19	4.1	54.7	2.9
2016/12/06	21:20	4.1	53.7	2.9
2016/12/06	21:21	4.1	57.4	2.9
2016/12/06	21:22	4.4	77.7	2.9
2016/12/06	21:23	4.4	66.7	2.9
2016/12/06	21:24	4.4	56.3	2.9
2016/12/06	21:25	4.4	59.1	2.9
Run 3 Average:		4.7	62.2	2.8

Hydrite Chemical Co
12/8/2020
Burner 1 - SBS Only

Pre Scrubber SO_2				Stripper Vent SO_2				Post Scrubber SO_2			
Calibration Error - Linearity Test											
Cylinder Value (ppmv)	SO_2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)
0.00	0.3	0.15%	PASS	0.00	0	0.00%	PASS	0.00	0	0.00%	PASS
100.6	99.4	0.58%	PASS	100.6	100.9	0.15%	PASS	100.6	100.2	0.19%	PASS
205.8	206.1	0.15%	PASS	205.8	206.2	0.19%	PASS	205.8	206.4	0.29%	PASS
Run 1 Pre-Bias											
Cylinder Value (ppmv)	SO_2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.05%	PASS	0.00	0.1	0.05%	PASS	0.00	1	0.49%	PASS
100.6	98.1	0.63%	PASS	100.6	101.2	0.15%	PASS	100.6	102.1	0.92%	PASS
Run 1 Post-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.4	0.19%	PASS	0.00	0.3	0.15%	PASS
100.6	98.4	0.49%	PASS	100.6	101.2	0.15%	PASS	100.6	102.4	1.07%	PASS
Calibration Drift Checks											
SO_2 zero	SO_2 mid			SO_2 zero	SO_2 mid			SO_2 zero	SO_2 mid		
0.05%	0.15%			0.15%	0.00%			0.34%	0.15%		
PASS	PASS			PASS	PASS			PASS	PASS		
Run 2 Pre-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.4	0.19%	PASS	0.00	0.3	0.15%	PASS
100.6	98.4	0.49%	PASS	100.6	101.2	0.15%	PASS	100.6	102.4	1.07%	PASS
Run 2 Post-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.4	0.05%	PASS	0.00	0.3	0.15%	PASS	0.00	0.3	0.15%	PASS
100.6	99.3	0.05%	PASS	100.6	100.7	0.10%	PASS	100.6	100.4	0.10%	PASS
Calibration Drift Checks											
SO2 zero	SO2 mid			SO2 zero	SO2 mid			SO2 zero	SO2 mid		
0.05%	0.44%			0.05%	0.24%			0.00%	0.97%		
PASS	PASS			PASS	PASS			PASS	PASS		
Run 3 Pre-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS	0.00	0.3	0.15%	PASS
100.6	99.3	0.63%	PASS	100.6	100.7	0.10%	PASS	100.6	100.4	0.10%	PASS
Run 3 Post-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.2	0.10%	PASS	0.00	0.1	0.05%	PASS
100.6	98.5	0.44%	PASS	100.6	102.3	0.68%	PASS	100.6	102.5	1.12%	PASS
Calibration Drift Checks											
SO2 zero	SO2 mid			SO2 zero	SO2 mid			SO2 zero	SO2 mid		
0.05%	0.39%			0.05%	0.78%			0.10%	1.02%		
PASS	PASS			PASS	PASS			PASS	PASS		

Hydrite Chemical Co
12/8/2020
Burner 1 - SBS & MBS

Pre Scrubber SO_2 | **Stripper Vent SO_2** | **Post Scrubber SO_2**

Calibration Error - Linearity Test

Cylinder Value (ppmv)	SO_2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)
0.00	0.3	0.15%	PASS	0.00	0	0.00%	PASS	0.00	0	0.00%	PASS
100.6	99.4	0.58%	PASS	100.6	100.9	0.15%	PASS	100.6	100.2	0.19%	PASS
205.8	206.1	0.15%	PASS	205.8	206.2	0.19%	PASS	205.8	206.4	0.29%	PASS

Run 1 Pre-Bias

Cylinder Value (ppmv)	SO_2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.2	0.10%	PASS	0.00	0.1	0.05%	PASS
100.6	98.5	0.44%	PASS	100.6	102.3	0.68%	PASS	100.6	102.5	1.12%	PASS

Run 1 Post-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.05%	PASS	0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS
100.6	99.5	0.05%	PASS	100.6	100.3	0.29%	PASS	100.6	101.5	0.63%	PASS

Calibration Drift Checks

SO_2 zero	SO_2 mid	SO_2 zero	SO_2 mid	SO_2 zero	SO_2 mid
0.05%	0.49%	0.00%	0.97%	0.10%	0.49%
PASS	PASS	PASS	PASS	PASS	PASS

Run 2 Pre-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.05%	PASS	0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS
100.6	99.5	0.05%	PASS	100.6	100.3	0.29%	PASS	100.6	101.5	0.63%	PASS

Run 2 Post-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0	0.15%	PASS	0.00	0.3	0.15%	PASS	0.00	0.4	0.19%	PASS
100.6	100.4	0.49%	PASS	100.6	99.7	0.58%	PASS	100.6	101.4	0.58%	PASS

Calibration Drift Checks

SO2 zero	SO2 mid	SO2 zero	SO2 mid	SO2 zero	SO2 mid
0.10%	0.44%	0.05%	0.29%	0.05%	0.05%
PASS	PASS	PASS	PASS	PASS	PASS

Run 3 Pre-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS	0.00	0.4	0.19%	PASS
100.6	100.4	0.10%	PASS	100.6	99.7	0.58%	PASS	100.6	101.4	0.58%	PASS

Run 3 Post-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.1	0.10%	PASS	0.00	0.1	0.05%	PASS	0.00	0.1	0.05%	PASS
100.6	99.6	0.10%	PASS	100.6	101.2	0.15%	PASS	100.6	101.5	0.63%	PASS

Calibration Drift Checks

SO2 zero	SO2 mid	SO2 zero	SO2 mid	SO2 zero	SO2 mid
0.05%	0.39%	0.10%	0.73%	0.15%	0.05%
PASS	PASS	PASS	PASS	PASS	PASS

Calibration Drift Corrections

SBS Only Condition

	Uncorrected			Drift Corrected			Undiluted Values	
	PreScrubber	Stripper Vent	Post Scrubbber	Prescrubber	Stripper Vent	Post Scrubber	PreScrubber	Stripper Vent
Run 1	7.82	2.87	60.2	7.77	2.61	59.0	847	514
Run 2	7.71	2.91	58.9	7.52	2.56	58.3	819	503
Run 3	8.63	2.77	58.7	8.55	2.51	58.1	931	493
Average	8.06	2.85	59.27	7.95	2.56	58.5	866	503

SBS & MBS Condition

	Uncorrected			Drift Corrected			Undiluted Values	
	PreScrubber	Stripper Vent	Post Scrubbber	Prescrubber	Stripper Vent	Post Scrubber	PreScrubber	Stripper Vent
Run 1	8.08	2.84	62.8	7.93	2.62	61.8	864	515
Run 2	6.46	2.80	61.8	6.41	2.57	61.1	698	505
Run 3	4.74	2.84	62.2	4.62	2.65	61.6	503	521
Average	6.43	2.82	62.2	6.32	2.61	61.5	688	514

Gas Stream	Cal Gas	Reading	Dilution Ratio
Stripper Vent	1612	8.2	197
Pre-Scrubber	1612	14.8	109

Contract Number				
Client / Location	Hydrite			
Source	Post Mist Eliminator			
Location	Stack			
Sample Type / Method	1 ,2, 3, 4,25A			
Condition Number				Average
Run Number	1	2	3	
Method	1 ,2, 3, 4,25A	1 ,2, 3, 4,25A	1 ,2, 3, 4,25A	
Date	12/07/20	12/07/20	12/07/20	
Time Start (24-hr clock)	14:15	15:35	16:40	
Time Stop (24-hr clock)	15:15	16:35	17:40	
Total Collection Time (min)	60	60	60	
Pitot Tube Correction Factor	0.84	0.84	0.84	0.84
Stack ID (in)	12	12	12	
Equivalent Duct Diameter (ft)	1.00	1.00	1.00	1.00
Duct Cross-Sectional Area (ft^2)	0.785	0.785	0.785	0.79
Barometric Pressure (in. Hg)	29.75	29.75	29.75	29.75
Static Pressure (in. H_2O)	-0.50	-0.50	-0.50	-0.5
Absolute Stack Pressure (in. Hg)	29.71	29.71	29.71	29.71
O_2 (%)	20.9	20.9	20.9	20.9
CO_2 (%)	0.0	0.0	0.0	0.0
Dry Molecular Weight (g/g-mole)	28.8	28.8	28.8	28.8
Condensate (mL)	99.0	120.0	120.0	113.0
Calculated Moisture Content (%)	9.49	10.60	10.59	10.2
Moisture Used in Calculations (%)	9.49	10.60	10.59	
Wet Molecular Weight (g/g-mole)	27.81	27.69	27.69	27.73
Leak Check Vacuum (in hg)	10.00	10.00	10.00	
Leak Check Volume (ft^3)	0.000	0.000	0.000	
Meter Volume (ft^3)	42.603	46.819	46.734	45.385
Meter Calibration Factor, Y	1.050	1.050	1.050	1.050
Average Meter Temperature (F)	69.8	83.2	81.7	78.3
Average Delta H (in. H_2O)	1.7490	1.7490	1.7490	1.7490
Corrected Meter Volume (dry ft^3 at STP)	44.523	47.723	47.772	46.673
Average Stack Temperature (F)	123.0	123.0	124.0	123.0
Absolute Stack Temperature (R)	583.0	583.0	584.0	583.0
Average Square Root of delta P	1.20	1.20	1.20	1.20
Unadjusted Gas Velocity (ft/sec)	72.1	72.3	72.3	72.1
Corrected Flow Rate (wscfh)	183,260	183,658	183,497	183,260
Corrected Flow Rate (wscfm)	3,054	3,061	3,058	3,054
Corrected Flow Rate (kwscfm)	3	3	3	3
Corrected Flow Rate (dscfh)	165,871	164,192	164,066	165,871
Corrected Flow Rate (dscfm)	2,765	2,737	2,734	2,765
Corrected Flow Rate (kdscfh)	166	164	164	166

STP is defined as 528 R and 29.92 "Hg

Tabulated Data
Calculations
Data Entry

Run 1

Impinger No.	Initial Wt. (g)	Final Wt. (g)	Total Gain (g)
1	100.0	188.0	88
2	100.0	100.0	0
3	0.0	0.0	0
4	200.0	211.0	11
5			0
6			0
		sum =	99

	Time	dP	Stack	Meter Volume	Meter Temp	Impinger Temp	dH	SQRT dP
1	0	1.50	123.00	574.837	66.00	46.00	1.867	1.22
2	5	1.60	123.00	578.350	65.00	44.00	1.867	1.26
3	10	1.60	123.00	582.000	68.00	46.00	1.867	1.26
4	15	1.40	123.00	585.780	70.00	47.00	1.867	1.18
5	20	1.50	123.00	589.250	70.00	47.00	1.867	1.22
6	25	1.30	123.00	592.730	70.00	47.00	1.867	1.14
7	30	1.30	123.00	596.470	70.00	47.00	1.867	1.14
8	35	1.60	123.00	600.995	70.00	47.00	1.867	1.26
9	40	1.30	123.00	603.750	71.00	47.00	1.867	1.14
10	45	1.50	123.00	606.97	72.00	47.00	1.867	1.22
11	50	1.60	123.00	610.55	72.00	47.00	1.867	1.26
12	55	1.40	123.00	614.25	72.00	47.00	1.867	1.18
13	60	1.40	123.00	617.440	72.00	48.00	1.867	1.18
14		1.30	123.00				1.867	1.14
15		1.30	123.00				1.867	1.14
16		1.30	123.00				1.867	1.14
		1.43	**123.0**	**42.6**	**69.8**		**1.867**	**1.20**

Run 2

Impinger No.	Initial Wt. (g)	Final Wt. (g)	Total Gain (g)
1	100.0	210.0	110
2	100.0	100.0	0
3	0.0	0.0	0
4	200.0	210.0	10
5			0
6			0
		sum =	120

Time	dP	Stack	Meter Volume	Meter Temp	Impinger Temp	dH	SQRT dP
0	1.50	123.00	617.594	78.00	52.00	1.867	1.22
5	1.60	123.00	621.150	78.00	48.00	1.867	1.26
10	1.60	123.00	624.950	80.00	49.00	1.867	1.26
15	1.40	123.00	628.930	80.00	49.00	1.867	1.18
20	1.50	123.00	632.850	82.00	49.00	1.867	1.22
25	1.30	123.00	636.910	84.00	50.00	1.867	1.14
30	1.30	123.00	640.750	83.00	49.00	1.867	1.14
35	1.60	123.00	644.780	85.00	49.00	1.867	1.26
40	1.30	123.00	648.520	86.00	50.00	1.867	1.14
45	1.50	123.00	652.770	86.00	50.00	1.867	1.22
50	1.60	123.00	656.520	86.00	50.00	1.867	1.26
55	1.40	123.00	660.450	87.00	51.00	1.867	1.18
60	1.40	123.00	664.413	87.00	49.00	1.867	1.18
	1.30	123.00				1.867	1.14
	1.30	123.00				1.867	1.14
	1.30	123.00				1.867	1.14
	1.43	**123.0**	**46.8**	**83.2**		**1.867**	**1.20**

Run 3

Impinger No.	Initial Wt. (g)	Final Wt. (g)	Total Gain (g)
1	100.0	210.0	110
2	100.0	100.0	0
3	0.0	0.0	0
4	200.0	210.0	10
5			0
6			0
		sum =	120

Time	dP	Stack	Meter Volume	Meter Temp	Impinger Temp	dH	SQRT dP	SQRT dH
0	1.50	124.00	664.723	78.00	51.00	1.867	1.22	1.37
5	1.60	124.00	668.790	79.00	49.00	1.867	1.26	1.37
10	1.60	124.00	672.840	79.00	48.00	1.867	1.26	1.37
15	1.40	124.00	676.500	81.00	49.00	1.867	1.18	1.37
20	1.50	124.00	680.490	81.00	49.00	1.867	1.22	1.37
25	1.30	124.00	684.290	81.00	51.00	1.867	1.14	1.37
30	1.30	124.00	688.190	80.00	49.00	1.867	1.14	1.37
35	1.60	124.00	692.170	81.00	49.00	1.867	1.26	1.37
40	1.30	124.00	696.050	84.00	49.00	1.867	1.14	1.37
45	1.50	124.00	699.990	84.00	50.00	1.867	1.22	1.37
50	1.60	124.00	703.610	84.00	50.00	1.867	1.26	1.37
55	1.40	124.00	707.550	85.00	50.00	1.867	1.18	1.37
60	1.40	124.00	711.457	85.00	50.00	1.867	1.18	1.37
	1.30	124.00				1.867	1.14	1.37
	1.30	124.00				1.867	1.14	1.37
	1.30	124.00				1.867	1.14	1.37
	1.43	**124.0**	**46.7**	**81.7**		**1.867**	**1.20**	**1.36638208**

Contract Number				
Client / Location	Hydrite			
Source	Outlet			
Location				
Sample Type / Method	1 ,2, 3, 4,25A			
Condition Number				Average
Run Number	1	2	3	
Method	1 ,2, 3, 4,25A	1 ,2, 3, 4,25A	1 ,2, 3, 4,25A	
Date	12/07/20	12/07/20	12/07/20	
Time Start (24-hr clock)	18:05	19:15	20:30	
Time Stop (24-hr clock)	19:05	20:15	21:30	
Total Collection Time (min)	30	30	30	
Pitot Tube Correction Factor	0.84	0.84	0.84	0.84
Stack ID (in)	12	12	12	
Equivalent Duct Diameter (ft)	1.00	1.00	1.00	1.00
Duct Cross-Sectional Area (ft^2)	0.785	0.785	0.785	0.79
Barometric Pressure (in. Hg)	29.00	29.00	29.00	29.00
Static Pressure (in. H_2O)	-0.50	-0.50	-0.50	-0.5
Absolute Stack Pressure (in. Hg)	28.96	28.96	28.96	28.96
O_2 (%)	20.9	20.9	20.9	20.9
CO_2 (%)	0.0	0.0	0.0	0.0
Dry Molecular Weight (g/g-mole)	28.8	28.8	28.8	28.8
Condensate (mL)	112.0	114.0	114.0	113.3
Calculated Moisture Content (%)	10.71	10.72	10.61	10.68
Moisture Used in Calculations (%)	10.71	10.72	10.61	10.68
Wet Molecular Weight (g/g-mole)	27.68	27.67	27.69	27.68
Leak Check Vacuum (in hg)	10.00	10.00	10.00	
Leak Check Volume (ft^3)	0.000	0.000	0.000	
Meter Volume (ft^3)	44.498	45.280	45.882	45.220
Meter Calibration Factor, Y	1.050	1.050	1.050	1.050
Average Meter Temperature (F)	85.6	86.1	86.9	86.2
Average Delta H (in. H_2O)	1.7490	1.7490	1.7490	1.7490
Corrected Meter Volume (dry ft^3 at STP)	44.026	44.762	45.287	44.691
Average Stack Temperature (F)	120.0	121.0	120.0	120.0
Absolute Stack Temperature (R)	580.0	581.0	580.0	580.0
Average Square Root of delta P	1.34	1.35	1.35	1.34
Unadjusted Gas Velocity (ft/sec)	81.8	82.6	82.7	81.8
Corrected Flow Rate (wscfh)	203,825	205,455	205,947	203,825
Corrected Flow Rate (wscfm)	3,397	3,424	3,432	3,397
Corrected Flow Rate (kwscfm)	3	3	3	3
Corrected Flow Rate (dscfh)	181,996	183,429	184,097	181,996
Corrected Flow Rate (dscfm)	3,033	3,057	3,068	3,033
Corrected Flow Rate (kdscfh)	182	183	184	182

STP is defined as 528 R and 29.92 "Hg

	Tabulated Data
	Calculations
	Data Entry

Run 1

Impinger No.	Initial Wt. (g)	Final Wt. (g)	Total Gain (g)
1	100.0	204.0	104
2	100.0	100.0	0
3	0.0	0.0	0
4	200.0	208.0	8
5			0
6			0
		sum =	112

Time	dP	Stack	Meter Volume	Meter Temp	Impinger Temp	dH	SQRT dP
0	1.40	120.00	711.779	83.00	49.00	1.867	1.18
5	1.70	120.00	715.850	84.00	45.00	1.867	1.30
10	1.80	120.00	719.650	84.00	45.00	1.867	1.34
15	1.80	120.00	722.830	84.00	45.00	1.867	1.34
20	1.80	120.00	726.850	85.00	45.00	1.867	1.34
25	2.00	120.00	730.250	84.00	45.00	1.867	1.41
30	1.90	120.00	733.800	85.00	45.00	1.867	1.38
35	2.00	120.00	737.550	86.00	45.00	1.867	1.41
40	1.40	120.00	741.450	87.00	45.00	1.867	1.18
45	1.70	120.00	745.550	87.00	45.00	1.867	1.30
50	1.80	120.00	749.150	88.00	45.00	1.867	1.34
55	1.80	120.00	752.240	88.00	45.00	1.867	1.34
60	1.80	120.00	756.277	88.00	45.00	1.867	1.34
	2.00	120.00					1.41
	1.90	120.00					1.38
	2.00	120.00					1.41
	1.80	**120.0**	**44.5**	**85.6**		**1.867**	**1.34**

Run 2

Impinger No.	Initial Wt. (g)	Final Wt. (g)	Total Gain (g)
1	100.0	202.0	102
2	100.0	102.0	2
3	0.0	0.0	0
4	200.0	210.0	10
5			0
6			0
		sum =	114

Time	dP	Stack	Meter Volume	Meter Temp	Impinger Temp	dH	SQRT dP
0	1.50	121.00	756.487	83.00	51.00	1.867	1.22
5	1.70	121.00	759.700	84.00	46.00	1.867	1.30
10	1.80	121.00	763.750	85.00	46.00	1.867	1.34
15	1.80	121.00	767.420	85.00	46.00	1.867	1.34
20	1.90	121.00	771.400	85.00	46.00	1.867	1.38
25	1.90	121.00	774.820	86.00	46.00	1.867	1.38
30	2.00	121.00	778.740	86.00	46.00	1.867	1.41
35	2.00	121.00	782.560	87.00	46.00	1.867	1.41
40	1.40	121.00	786.340	87.00	46.00	1.867	1.18
45	1.80	121.00	789.780	87.00	46.00	1.867	1.34
50	1.80	121.00	793.950	88.00	46.00	1.867	1.34
55	1.90	121.00	797.320	88.00	46.00	1.867	1.38
60	1.90	121.00	801.767	88.00	46.00	1.867	1.38
	1.90	121.00					1.38
	2.00	121.00					1.41
	2.00	121.00					1.41
	1.83	**121.0**	**45.3**	**86.1**		**1.867**	**1.35**

Run 3

Impinger No.	Initial Wt. (g)	Final Wt. (g)	Total Gain (g)
1	100.0	204.0	104
2	100.0	100.0	0
3	0.0	0.0	0
4	200.0	210.0	10
5			0
6			0
		sum =	114

Time	dP	Stack	Meter Volume	Meter Temp	Impinger Temp	dH	SQRT dP
0	1.40	120.00	801.816	82.00	46.00	1.867	1.18
5	1.80	120.00	805.790	84.00	46.00	1.867	1.34
10	1.80	120.00	809.845	84.00	46.00	1.867	1.34
15	1.80	120.00	813.450	86.00	46.00	1.867	1.34
20	2.00	120.00	817.240	86.00	47.00	1.867	1.41
25	2.00	120.00	821.670	87.00	47.00	1.867	1.41
30	1.90	120.00	825.090	88.00	47.00	1.867	1.38
35	1.90	120.00	829.100	88.00	47.00	1.867	1.38
40	1.50	120.00	832.210	88.00	47.00	1.867	1.22
45	1.80	120.00	835.950	89.00	47.00	1.867	1.34
50	1.80	120.00	839.450	89.00	48.00	1.867	1.34
55	1.90	120.00	843.900	89.00	48.00	1.867	1.38
60	2.00	120.00	847.698	90.00	48.00	1.867	1.41
	1.90	120.00					1.38
	2.00	120.00					1.41
	1.90	120.00					1.38
	1.84	**120.0**	**45.9**	**86.9**		**1.867**	**1.35**

		Flow Rates (dscfh)			SO_2 Concentration (ppm)			SO_2 Emission Rate (lbs/hr)			SO_2 Removal Efficiency
Process Condition	Run #	Pre-Scrubber	Stripper Vent	Post Scrubber	Pre-Scrubber	Stripper Vent	Post Scrubber	Pre-Scrubber	Stripper Vent	Post Scrubber	(%)
SBS	Run 1	164,879	991	165,871	847	514	59.0	23.2	0.085	1.63	93.0%
	Run 2	163,201	991	164,192	819	503	58.3	22.2	0.083	1.59	92.9%
	Run 3	163,075	991	164,066	931	493	58.1	25.3	0.081	1.59	93.7%
	Average:		991	164,710	866	503	58.5	23.6	0.083	1.60	93.2%
SBS & MBS	Run 1	181,004	991	181,996	864	515	61.8	26.0	0.085	1.87	92.8%
	Run 2	182,438	991	183,429	698	505	61.1	21.2	0.083	1.86	91.2%
	Run 3	183,106	991	184,097	503	521	61.6	15.3	0.086	1.89	87.8%
	Average:	182,183	991	183,174	688	514	61.5	20.8	0.085	1.87	91.0%

Molecular Weight of SO2 64.066
Assumption: stripper vent is rated for 80 lbs/hr
Molecular Weight of Stack Gas 27.7
One standard cubic foot of gas weighs 0.0807 lbs
80lbs/hr results in 991.32 standard cubic feet

Standard cubic feet per hour 991 from Stripper Vent

APPENDIX C

Calibration Data

Pitot Tube Calibration

Calibration Date:	5/26/2016
Probe Number/ID:	M2-3-1
External Tubing Diamater:	none

Calibrators Initials: JB

	Measured	Pass/Fail
PA/Dt	1.301812451	TRUE
PB/Dt	1.434200158	TRUE
Angle α 1	0.16	Pass
Angle α 2	0.16	Pass
Angle β 1	0.05	Pass
Angle β 2	0.05	Pass
z (cm)		Pass
w (cm)		Pass
Pitot Coefficient	0.84	TRUE

Length x:	18.46	mm
Length y:	25.19	mm
Length z:	18.48	mm

PA:	8.26	mm
PB:	9.1	mm
Dt:	12.69	mm

Length A:	6.48	mm
Length B:	18.12	mm
Length C:	6.43	mm

Hydrite Chemical Co
12/7/2016
Burner 1 - SBS Only

WILCOX
ENVIRONMENTAL ENGINEERING

Pre Scrubber SO_2				**Stripper Vent SO_2**				**Post Scrubber SO_2**			
Calibration Error - Linearity Test											
Cylinder Value (ppmv)	SO_2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)
0.00	0.3	0.15%	PASS	0.00	0	0.00%	PASS	0.00	0	0.00%	PASS
100.6	99.4	0.58%	PASS	100.6	100.9	0.15%	PASS	100.6	100.2	0.19%	PASS
205.8	206.1	0.15%	PASS	205.8	206.2	0.19%	PASS	205.8	206.4	0.29%	PASS
Run 1 Pre-Bias											
Cylinder Value (ppmv)	SO_2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.05%	PASS	0.00	0.1	0.05%	PASS	0.00	1	0.49%	PASS
100.6	98.1	0.63%	PASS	100.6	101.2	0.15%	PASS	100.6	102.1	0.92%	PASS
Run 1 Post-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.4	0.19%	PASS	0.00	0.3	0.15%	PASS
100.6	98.4	0.49%	PASS	100.6	101.2	0.15%	PASS	100.6	102.4	1.07%	PASS
Calibration Drift Checks											
SO_2 zero	SO_2 mid			SO_2 zero	SO_2 mid			SO_2 zero	SO_2 mid		
0.05%	0.15%			0.15%	0.00%			0.34%	0.15%		
PASS	PASS			PASS	PASS			PASS	PASS		
Run 2 Pre-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.4	0.19%	PASS	0.00	0.3	0.15%	PASS
100.6	98.4	0.49%	PASS	100.6	101.2	0.15%	PASS	100.6	102.4	1.07%	PASS
Run 2 Post-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.4	0.05%	PASS	0.00	0.3	0.15%	PASS	0.00	0.3	0.15%	PASS
100.6	99.3	0.05%	PASS	100.6	100.7	0.10%	PASS	100.6	100.4	0.10%	PASS
Calibration Drift Checks											
SO2 zero	SO2 mid			SO2 zero	SO2 mid			SO2 zero	SO2 mid		
0.05%	0.44%			0.05%	0.24%			0.00%	0.97%		
PASS	PASS			PASS	PASS			PASS	PASS		
Run 3 Pre-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS	0.00	0.3	0.15%	PASS
100.6	99.3	0.63%	PASS	100.6	100.7	0.10%	PASS	100.6	100.4	0.10%	PASS
Run 3 Post-Bias											
Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.2	0.10%	PASS	0.00	0.1	0.05%	PASS
100.6	98.5	0.44%	PASS	100.6	102.3	0.68%	PASS	100.6	102.5	1.12%	PASS
Calibration Drift Checks											
SO2 zero	SO2 mid			SO2 zero	SO2 mid			SO2 zero	SO2 mid		
0.05%	0.39%			0.05%	0.78%			0.10%	1.02%		
PASS	PASS			PASS	PASS			PASS	PASS		

Hydrite Chemical Co
12/7/2016
Burner 1 - SBS & MBS

Pre Scrubber SO_2 | **Stripper Vent SO_2** | **Post Scrubber SO_2**

Calibration Error - Linearity Test

Cylinder Value (ppmv)	SO_2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	ERROR (%)	Result (PASS/FAIL)
0.00	0.3	0.15%	PASS	0.00	0	0.00%	PASS	0.00	0	0.00%	PASS
100.6	99.4	0.58%	PASS	100.6	100.9	0.15%	PASS	100.6	100.2	0.19%	PASS
205.8	206.1	0.15%	PASS	205.8	206.2	0.19%	PASS	205.8	206.4	0.29%	PASS

Run 1 Pre-Bias

Cylinder Value (ppmv)	SO_2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.3	0.00%	PASS	0.00	0.2	0.10%	PASS	0.00	0.1	0.05%	PASS
100.6	98.5	0.44%	PASS	100.6	102.3	0.68%	PASS	100.6	102.5	1.12%	PASS

Run 1 Post-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.05%	PASS	0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS
100.6	99.5	0.05%	PASS	100.6	100.3	0.29%	PASS	100.6	101.5	0.63%	PASS

Calibration Drift Checks

SO_2 zero	SO_2 mid	SO_2 zero	SO_2 mid	SO_2 zero	SO_2 mid
0.05%	0.49%	0.00%	0.97%	0.10%	0.49%
PASS	PASS	PASS	PASS	PASS	PASS

Run 2 Pre-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.05%	PASS	0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS
100.6	99.5	0.05%	PASS	100.6	100.3	0.29%	PASS	100.6	101.5	0.63%	PASS

Run 2 Post-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0	0.15%	PASS	0.00	0.3	0.15%	PASS	0.00	0.4	0.19%	PASS
100.6	100.4	0.49%	PASS	100.6	99.7	0.58%	PASS	100.6	101.4	0.58%	PASS

Calibration Drift Checks

SO2 zero	SO2 mid	SO2 zero	SO2 mid	SO2 zero	SO2 mid
0.10%	0.44%	0.05%	0.29%	0.05%	0.05%
PASS	PASS	PASS	PASS	PASS	PASS

Run 3 Pre-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.2	0.10%	PASS	0.00	0.3	0.15%	PASS	0.00	0.4	0.19%	PASS
100.6	100.4	0.10%	PASS	100.6	99.7	0.58%	PASS	100.6	101.4	0.58%	PASS

Run 3 Post-Bias

Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)	Cylinder Value (ppmv)	SO2 (ppmv)	BIAS (%)	Result (PASS/FAIL)
0.00	0.1	0.10%	PASS	0.00	0.1	0.05%	PASS	0.00	0.1	0.05%	PASS
100.6	99.6	0.10%	PASS	100.6	101.2	0.15%	PASS	100.6	101.5	0.63%	PASS

Calibration Drift Checks

SO2 zero	SO2 mid	SO2 zero	SO2 mid	SO2 zero	SO2 mid
0.05%	0.39%	0.10%	0.73%	0.15%	0.05%
PASS	PASS	PASS	PASS	PASS	PASS

GRASEBY NUTECH
EPA Method 5
Meter Box Calibration
Post-Test Orifice Method
English Meter Box Units, English K' Factor

CONVERSION FACTORS

1 mm Hg =	0.13330	kPa
1 cm =	0.39370	inch
1 mm =	0.03937	inch
1 cu ft =	28.32	liters

Filename: Q:\Air Analysis Services\Calibrations\DGM Calibrations\CURRENT DGM CALIBRATIONS\Current Yearly Cals\[5 pnt Cals dgm #1404012.xlsm]Orifice 3
Revised: 10/19/2011 Version: 1.01

Model #: Apex XC-522
Serial #: 1404012

DGM 1404012

Date: -------------------------> 2/9/2016
Barometric Pressure: ----------> 29.78 (in. Hg)
Theoretical Critical Vacuum:---> 14.05 (in. Hg)

!!!!!!!!!
IMPORTANT For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.
IMPORTANT The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).
!!!!!!!!!

---------------- DRY GAS METER READINGS ---------------- **-CRITICAL ORIFICE READINGS-**

Delta H (in H2O)	Time (min)	Volume Initial (cu ft)	Volume Final (cu ft)	Volume Total (cu ft)	Initial Temps. Inlet (deg F)	Initial Temps. Outlet (deg F)	Final Temps. Inlet (deg F)	Final Temps. Outlet (deg F)	Orifice (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in Hg)	Ambient Temperature Initial (deg F)	Ambient Temperature Final (deg F)	Ambient Temperature Average (deg F)	Average Temperatures DGM Outlet (deg R)	Average Temperatures DGM Overall (deg R)	Average Temperatures Ambient Temp (deg R)
1.60	5.00	832.135	835.570	3.435	60.0	60.0	61.0	61.0	3	0.561	21.5	57.0	57.0	57.0	520.5	520.5	517.0
1.60	5.00	835.570	839.015	3.445	61.0	61.0	62.0	62.0	3	0.561	21.5	57.0	57.0	57.0	521.5	521.5	517.0
1.60	5.00	839.015	842.475	3.460	62.0	62.0	63.0	63.0	3	0.561	21.5	57.0	57.0	57.0	522.5	522.5	517.0

** RESULTS **

--- DRY GAS METER --- VOLUME CORRECTED Vm(std) (cu ft)	VOLUME CORRECTED Vm(std) (liters)	--------- ORIFICE --------- VOLUME CORRECTED Vcr(std) (cu ft)	VOLUME CORRECTED Vcr(std) (liters)	VOLUME NOMINAL Vcr (cu ft)	-- DRY GAS METER -- CALIBRATION FACTOR Y Value (number)	Variation (number)	--------- ORIFICE --------- CALIBRATION FACTOR Delta H@ Value (in H2O)	Value (mm H2O)	Variation (in H2O)
3.480	98.6	3.674	104.0	3.616	1.056	0.002	1.683	42.75	0.003
3.484	98.7	3.674	104.0	3.616	1.054	0.001	1.680	42.67	0.000
3.492	98.9	3.674	104.0	3.616	1.052	-0.002	1.677	42.59	-0.003
			Average Y ------->		1.054		1.680	42.67	<------- Average dH@

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H20 that equates to 0.75 cfm of air at 68 F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +-0.2.

SIGNED:____ **date:2/9/2016**

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
Airgas.com

Part Number:	E04NI99E15A55K9	Reference Number:	54-124509438-3
Cylinder Number:	SG9163439BAL	Cylinder Volume:	144.4 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12015	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Aug 28, 2015

Expiration Date: Aug 28, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	200.0 PPM	203.2 PPM	G1	+/- 1.0% NIST Traceable	08/21/2015, 08/28/2015
CARBON MONOXIDE	200.0 PPM	203.4 PPM	G1	+/- 0.8% NIST Traceable	08/21/2015
NITRIC OXIDE	200.0 PPM	203.1 PPM	G1	+/- 0.8% NIST Traceable	08/21/2015, 08/28/2015
SULFUR DIOXIDE	200.0 PPM	205.8 PPM	G1	+/- 0.9% NIST Traceable	08/21/2015, 08/28/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062431	CC366888	487.1 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 22, 2018
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 14, 2012
NTRM	15060348	CC448767	241.0 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Mar 30, 2021
GMIS	0207201402	CC500987	4.845 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 07, 2017
NTRM	11060857	CC343557	241 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.9%	May 13, 2017

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Jul 28, 2015
Nexus 470 AEP0000428	FTIR	Jul 28, 2015
Nexus 470 AEP0000428	FTIR	Jul 28, 2015
Nexus 470 AEP0000428	FTIR	Jul 28, 2015

Triad Data Available Upon Request

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
Airgas.com

Part Number:	E04NI99E15A0568	Reference Number:	54-124515134-1
Cylinder Number:	CC445121	Cylinder Volume:	144.4 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12015	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Oct 06, 2015

Expiration Date: Oct 06, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	100.3 PPM	G1	+/- 1.0% NIST Traceable	09/29/2015, 10/06/2015
CARBON MONOXIDE	100.0 PPM	101.0 PPM	G1	+/- 0.7% NIST Traceable	09/29/2015
NITRIC OXIDE	100.0 PPM	100.3 PPM	G1	+/- 1.0% NIST Traceable	09/29/2015, 10/06/2015
SULFUR DIOXIDE	100.0 PPM	100.6 PPM	G1	+/- 1.1% NIST Traceable	09/29/2015, 10/06/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062252	CC366857	97.56 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	May 25, 2018
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 14, 2012
NTRM	13061007	CC422721	99.86 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Nov 19, 2019
GMIS	0207201402	CC500987	4.845 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 07, 2017
NTRM	11060857	CC343557	241 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.9%	May 13, 2017

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Sep 28, 2015
Nexus 470 AEP0000428	FTIR	Sep 28, 2015
Nexus 470 AEP0000428	FTIR	Sep 28, 2015
Nexus 470 AEP0000428	FTIR	Sep 28, 2015

Triad Data Available Upon Request

Approved for Release

Airgas

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
www.airgas.com

Part Number:	E04NI99E15A0030	Reference Number:	54-124449592-1
Cylinder Number:	SG9151541BAL	Cylinder Volume:	144.5 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12014	Valve Outlet:	660
Gas Code:	CO,NO,SO2,BALN	Certification Date:	Aug 28, 2014

Expiration Date: Aug 28, 2022

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	1600 PPM	1609 PPM	G1	+/- 0.6% NIST Traceable	08/21/2014, 08/28/2014
CARBON MONOXIDE	1600 PPM	1618 PPM	G1	+/- 1.1% NIST Traceable	08/21/2014
NITRIC OXIDE	1600 PPM	1609 PPM	G1	+/- 0.6% NIST Traceable	08/21/2014, 08/28/2014
SULFUR DIOXIDE	1600 PPM	1612 PPM	G1	+/- 0.6% NIST Traceable	08/21/2014, 08/28/2014
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12060727	CC356175	2498 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Dec 21, 2017
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 14, 2012
NTRM	10060733	CC323321	1496 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Apr 29, 2016
GMIS	124206889102	CC320508	4.979 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	May 04, 2015
NTRM	07120508	CC238018	1489 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.5%	Mar 23, 2017

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Aug 11, 2014
Nexus 470 AEP0000428	FTIR	Aug 11, 2014
Nexus 470 AEP0000428	FTIR	Aug 11, 2014
Nexus 470 AEP0000428	FTIR	Aug 11, 2014

Triad Data Available Upon Request

Approved for Release

APPENDIX D

Submitted Protocol

Test Protocol for Sulfur Dioxide Emissions Testing

Hydrite Chemical.
Terre Haute, IN

Prepared For:
Hydrite Chemical
1330 Lock Port Rd
Terre Haute IN, 47802

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1.0 INTRODUCTION

Wilcox Environmental Engineering, Inc., Air Analysis Division Services (Wilcox) will be conducting source emissions testing on December 6th at the Hydrite Chemical Company in fulfillment of this test plan on the Bisulfite Processing Line Final Scrubber (WS-510) in response to the applicable EPA 114 request.

Hydrite Chemical Company intends to conduct the stack test of burner 1 with 19,440 lb/hr SBS and then add in 4,008 lb/hr MBS. A second testing scenario will be conducted with the SBS operating alone. The testing rates listed above are the maximum production rates that this equipment will tolerate.

Table 1-1 below presents the emission unit(s) and parameters to be tested. The test will be conducted in basic accordance with approved Environmental Protection Agency (EPA) Registered Test Methods and any pre-approved deviations discussed in this protocol.

Table 1-1. Emissions Sampling Summary

TEST LOCATION	PARAMETER	TEST METHOD	# OF TEST RUNS	SAMPLE DURATION (MIN)	ANALYTICAL APPROACH
POST MIST ELLIMINATOR	EXHAUST FLOW EXHAUST TEMP O2/CO2 MOISTURE	USEPA METHOD 1,2 USEPA METHOD 1,2 USEPA METHOD 3 USEPA METHOD 4	3 3 3 3	BATCH	PITOT TUBE THERMOCOUPLE FYRITE TEST KIT GRAVIMETRIC
PRE SCRUBBER; STRIPPER VENT; POST SCRUBBER	SO2	USEPA METHOD 6C	3	BATCH	UV ABSORPTION

A list of personnel involved with testing is provided below in Table 1-2.

Table 1-2. Project Personnel

Firm	Contact	Title	Phone No.
Wilcox	Dave Williams	Technical Director	317.472.0999
Hydrite	Jordan Abrell	EHS Coordinator	812.232.5411

2.0 FACILITY DESCRIPTION AND SOURCE INFORMATION

The source is a stationary food grade ammonium, sodium, and magnesium bisulfite production facility.

The unit tested is a (1) continuous magnesium, ammonium, and sodium bisulfite production process, constructed in 1993, with a maximum product capacity of 7,500 pounds of magnesium bisulfite per hour, 4,500 pounds of ammonium bisulfite per hour, and 20,000 pounds of sodium bisulfite per hour, and consisting of the following:

(1) One (1) absorption tower, identified as WS-430, using a 25% caustic solution pH controlled scrubber, and exhausting to stack ST-260.
(2) One (1) heat exchanger, identified as HE-437.
(3) One (1) wash tower, identified as WS-450, using a 25% caustic solution pH controlled scrubber, and exhausting to stack ST-260.
(4) One (1) absorption tower, identified as WS-440, using a 25% caustic solution pH controlled scrubber, and exhausting to stack ST-260.
(5) One (1) heat exchanger, identified as HE-447.
(6) One (1) wash/mist eliminator tower, identified as WS-720, and exhausting to stack ST-260.
(7) Two (2) absorption towers, identified as WS-410 and WS-420, using a 25% caustic solution pH controlled scrubber, and exhausting to stack ST-260.
(8) Three (3) heat exchangers, identified as HE-417, HE-427, and HE-517.
(9) One (1) scrubbing tower, identified as WS-510, using a 25% caustic solution pH controlled scrubber, and exhausting to stack ST-260.

Test Conditions:

Worst case scenario is considered to be operating conditions that process 19,440 lb/hr of SBS and 4,008 lb/hr of MBS. During testing, the unit will operate at least 95% of these conditions. The bullet list below contains the normal system operating ranges.

- Burner temperature: range 2,200 - 2,600 degrees F
- Air blowers: range 20 - 40 Hz – measures air input to system.
- Sulfur blower: range 20 - 45 Hz – measures Sulfur input to system.
- System pressure (before scrubber): 6 - 12 psi

3.0 SUMMARY OF EVENTS

The sampling procedures to be utilized by Wilcox will be performed according to Title 40 CFR Part 60 Appendix A as follows:

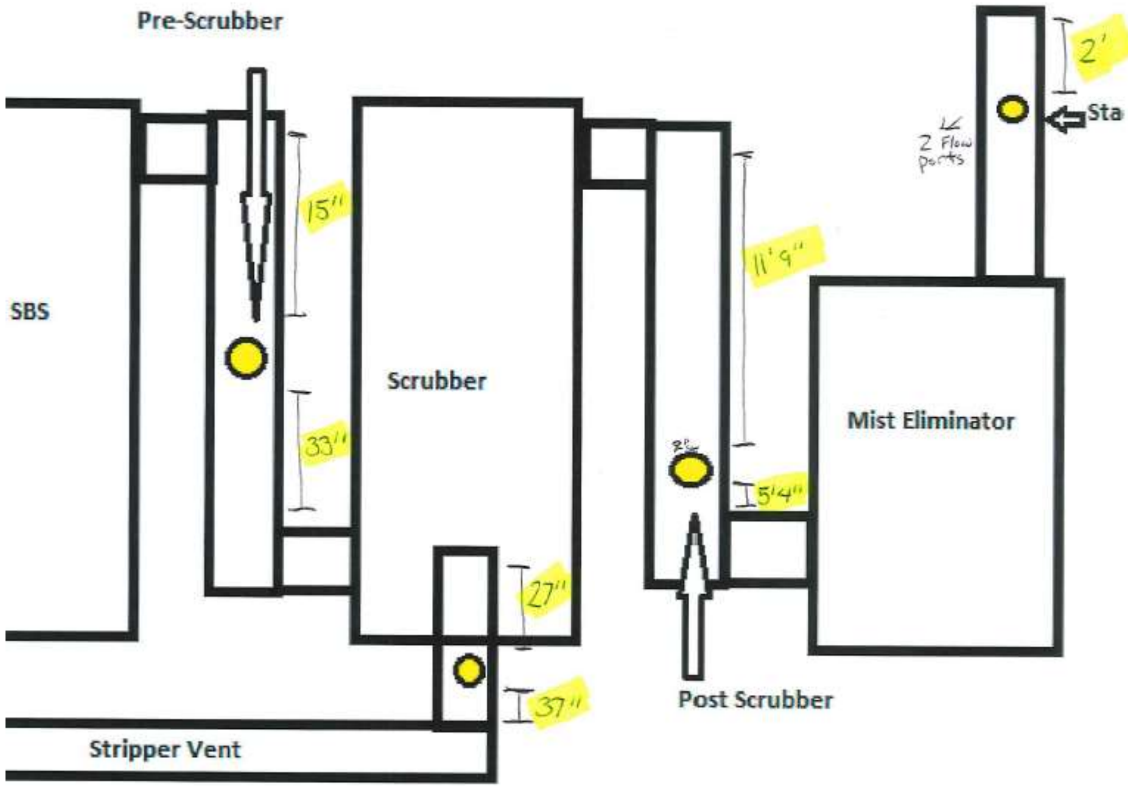
Table 3-1. Sampling Procedures

Method	Description
US EPA Method 1	Determination of Velocity Traverses for Stationary Sources
US EPA Method 2	Determination of Stack Gas Velocity and Volumetric Flow Rate
US EPA Method 3	Gas Analysis for the Determination of Molecular Weight
US EPA Method 4	Determination of Moisture Content in Stack Gas
US EPA Method 6C	Determination of SO2 Emissions

3.1 Sample Point Determination – EPA Method 1

Sampling point locations are determined according to EPA Reference Method 1 as applicable and required. A diagram demonstrating distance from port location to nearest disturbances is presented below in Figure 3-1.

Figure 2-1 Sample Site Schematic



*All ducts have 12" inside diameters

3.2 Velocity and Volumetric Flow Rate – EPA Method 2

EPA Method 2 will be used to determine the gas velocity and flow rate at the stack. Each set of velocity determinations included the measurement of gas velocity pressure and gas temperature at each of the Method 1 determined traverse points. The velocity pressures will be measured with a Type S pitot tube. Gas temperature measurements will be made with a Type K thermocouple and digital pyrometer.

3.3 Gas Composition and Molecular Weight – EPA Method 3

The oxygen and carbon dioxide concentrations will be determined in accordance with EPA Method 3 using a Fyrite analyzer. The remaining stack gas constituent will be assumed to be nitrogen for the stack gas molecular weight determination.

3.4 Moisture Content – EPA Method 4

The flue gas moisture content at the testing locations will be determined in accordance with EPA Method 4. The gas moisture will be determined by quantitatively measuring condensed moisture in the chilled impingers and silica absorption. The amount of moisture condensed will be determined gravimetrically. A dry gas meter will be used to measure the volume of gas sampled. Moisture content is used to determine stack gas velocity.

3.5 SO2 Determination – EPA Method 6C

Stack gas will be withdrawn from the stack and conditioned (moisture is removed) before being analyzed by ultra-violet (UV) detection. Sulfur Dioxide molecules are absorbed by specific wave lengths. Molecular absorption is directly proportional to the concentration of SO2. Quality assurance of the analyzer will first be determined by direct injection of known EPA protocol 1 gas concentrations. A system check of the probe, connection lines and conditioner will also be determined prior to and after each sample period to determine drift bias. Method 6C was chosen over method 6 for the safety of the sampling personnel. The pre-scrubber, stripper vent and post scrubber test locations are all under considerable positive pressure. Conducting the stack test using Method 6 is deemed unsafe due to the positive pressure and risk of stack testing personnel potentially being exposed to high levels of SO2. These risks are mitigated if Method 6C is used. We are proposing that Method 6C be used for the stack test.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

4.1 Sampling Protocol

Wilcox Environmental Engineering (Wilcox) is organized to facilitate sample management, analytical performance management, and data management. Personnel are assigned specific tasks to ensure implementation of the quality assurance/quality control (QA/QC) program. The Senior Project Manager in charge of air emission measurement projects report directly to the Director of Air Analysis Services and are the QA officers responsible for program effectiveness and compliance.

The analysts perform the data reduction, analyses, and initial data review. Each analyst must check and initial their work, making certain that it is complete, determining that any instrumentation utilized has been properly calibrated, and ensuring that the analysis has been performed within the QA/QC limits.

The Senior Project Manager evaluate the data submitted by the analysts and verify that the data and documentation are complete, that all analyses has been performed within QA criteria specific to each method, checks calculations, assembles and signs the data package, and prepares the final report.

4.2 Equipment Maintenance and Calibration

The Field Supervisor and Field Technicians are in charge of routine maintenance and calibration of all source-testing equipment. Relevant calibration information is included in the Appendices of this report.

4.2.1 Equipment Maintenance

All major pieces of equipment have maintenance logs where all maintenance activities are recorded and documented. Table 4-1 shows routine maintenance that is performed on Wilcox source testing equipment.

Table 4-1. Test Equipment - Routine Maintenance Schedule

Equipment	Acceptance Limits	Frequency of Service	Methods of Service
Pumps	• Absence of leaks • Ability to draw vacuum within equipment specifications	Every 500 hours of operation or 6-months, whichever is less	• Visual inspection • Lubrication
Flow Meters	• Free mechanical movement • Absence of malfunction • Calibration within tolerance	Every 500 hours of operation or 6-months whichever is less	• Visual inspection • Clean • Calibrate
Electronic Instrumentation	• Absence of malfunction • Proper response to calibration gases and signals	As recommended by manufacturer or when required due to unacceptable limits	• Clean • Replace parts as necessary • Other recommended manufacturer service
Mobile Laboratory Sampling System	• Absence of leaks. • Sample lines clean and free of debris • Proper input flow rates to analyzers	At least once per month or sooner depending on nature of use.	• Change filters • Change gas dryer • Leak check • Check for contamination
Sample Lines	• Absence of soot and particulate buildup • Adequate sample flow	At least once per month or sooner depending on nature of use.	• Flush with solvents and water • Heat and purge line with nitrogen

4.2.2 Equipment Calibration

Current calibration information on equipment used during testing is included in the Appendices of this report.

The S-Type pitot tubes are calibrated initially upon purchase and then semiannually. Visual measurements are taken prior to each use to insure accidental damage has not occurred. Measurements are performed using a micrometer and protractor.

Each temperature sensor is marked and identified. This is done by marking each thermocouple end connector with a number. The sensor is calibrated as a unit with the control box potentiometer and associated lead wire as an identified unit. Calibrations are performed initially and annually at three set-points over the range of expected temperatures for that particular thermocouple. A reference output-voltage/thermocouple calibrator is used as a temperature reference source for the multi-point calibrations.

The field barometer is adjusted initially and semiannually to within 0.1 "Hg of the actual atmospheric pressure at the Wilcox laboratory facility in Indianapolis, Indiana. All dry gas field meters are calibrated before initial use. Once the meter is placed in operation, its calibration is checked after each test series or bimonthly, whichever is less. Dry gas meters are calibrated against a NIST reference meter or orifice.

The dry gas meter orifice is calibrated before its initial use and then annually. This calibration is performed during the calibration of the dry gas test meter. The unit is checked in the field after every series of tests using a field gas-meter check procedure.

Analytical balances are internally calibrated prior to use following the manufacturer's instructions. The balances are further checked using Class S-1 analytical weights prior to daily usage. Field top loading balances are checked with a field analytical weight prior to usage.

5.0 DATA REDUCTION VALIDATION AND REPORTING

The data presented in final reports are reviewed three times. First, the analyst reviews and certifies that the raw data complies with technical controls, documentation requirements, and standard group procedures. Second, the Senior Project Manager reviews and certifies that data packages comply to specifications for sample holding conditions, chain of custody, data documentation, and the final report is free of transcription errors. Third, a QA review is performed by additional senior personnel. This review thoroughly examines the entire completed data report. Once the review process is completed, the report is approved by Wilcox senior personnel and issued. All raw laboratory data and final reports are stored for a minimum of 5 years.

6.0 FINAL REPORT FORMAT

As prepared by Wilcox, the Performance Test Report will consist of the following:

Cover Page;

Table of Contents;

Executive Summary;

Introduction;

Description of Process Equipment and Control Devices;

Description of Sampling Locations;

Test Results and Critique;

Records of Operating Conditions during the Tests;

Summary of Sampling and Analytical Procedures;

Quality Assurance; and

Appendices (i.e. source test result summaries, raw data from field and laboratory analyses; preliminary data, calculation sheets, laboratory data, and QA/QC back-up data sheets).

The test results and critique section will include applicable rules and permit conditions and the applicable source test data computed to satisfy rule requirements. This section will also include a summary of the test events and a detailed account of any problems encountered during the testing. A brief equipment and process description will be included in the final report indicating equipment-operating parameters during the testing. Simple schematics of the process will show all sampling locations, including upstream and downstream disturbances.

All sampling and analytical procedures will specifically detail all aspects of sampling and analysis. Diagrams of test equipment will be provided.

The appendices to the final report will include complete raw field data, including production data indicative of the testing interval, lab analyses, and test results. All calculations will be shown. The appendices will also contain current calibration data for all applicable equipment and calibration gases used for the testing if relevant.

In accordance with the reporting requirements as stipulated by the EPA, a final source test report will be submitted to the Division within sixty days of the completion of the field test program.